YAYASAN TUMBUH-TUMBUHAN YANG BERGUNA
FOUNDATION FOR USEFUL PLANTS OF TROPICAL ASIA
VOLUME III

A HANDBOOK OF THE DIPTEROCARPACEAE OF SRI LANKA

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Wildlife Heritage Trust of Sri Lanka

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ISBN 955-9114-05-0

Manufactured in the Republic of Indonesia

Published by the Wildlife Heritage Trust of Sri Lanka, Colombo 8, Sri Lanka

Printed by PT Gramedia, Jakarta under supervision of PT Gramedia Pustaka Utama (Publisher), Jakarta

15 14 13 12 11 10 9 8 7 6 5 4 3 2 1

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PREFACE

Since the publication of P. Ashton's revision of the Dipterocarpaceae of Sri Lanka in 1977 (reprinted in 1980), a fair number of changes have appeared in this family, a large number of new species has been published in periodicals not always easily accessible and, hence, we thought it appropriate to bring together in a single volume an up-to-date overview of the family in Sri Lanka.

Dipterocarpaceae are now considered a purely Asiatic family; the sub-family Monotoideae has been raised to family rank (Monotaceae) occurring in tropical Africa and in South America (the former sub-family Pakaraimoideae Ashton and Maguire), a family closely related to Tiliaceae. The name Monotaceae appeared for the second time (after Maury's thesis) in Takhtazhian's Systema Magnoliophytorum, Officina editoria Nauk, Leningrad: 129. 1978, but as cited Monotaceae Maury, a name not properly published and the name not valid. The family name appeared properly in Taxon 38: 123. 1989.

Apart from the characteristics enumerated by me in Taxon 34: 426. 1985, the Monotaceae deviate from the Dipterocarpaceae by lacking resin ducts and having a different chemistry (Dias & al. 1966). Of Pakaraimoideae Hegnauer (in Ashton in Fl. Males. 9(2): 274. 1982) made the remark that the chemical affinity to Asiatic Dipterocarpaceae as presented by Gianassi & Niklas (1977) was inadequate.

The remark by Ashton in his revision of Malesian Dipterocarpaceae (1982) that Pakaraimaea was definitely proved to belong to Dipterocarpaceae has been thoroughly refuted. There is nothing definite in plant taxonomy. A similar mistake was made by Symington, who once pretended that the circumscription of Vatica was definitely established.*

We have deemed it necessary to break-up the genus Vatica and have re-instated the genus *Sunaptea* Griff., for those species provided with real well-

*A 8-page typescript paper by Kochummen (Forest Research Institute, Kepong, Malaysia) with corrections of mistakes and omissions in Ashton's paper, has been distributed to main Herbaria. Unluckily these valuable corrections have so far not been published as an Addendum in Flora Malesiana.

to stay several times at their quarters in Weddegalle, at the entrance of Sinharaja forest.

There are numerous other people to which we want to extend our feelings of gratefulness, like the Director of the small Hospital in Hiniduma, where we spent some nights, the care of the Catholic Sisters at the Convent in Hiniduma who looked after our team better than anywhere else, the driver of my jeep, and the treeclimber Sumeni (mentioned elsewhere) who helped a great deal in making my collecting trips a great success. Hospitality was even extended to us by our guide to Hinidum Kande, in his small house at the base of that mountain.

We spent also some time at the home of the father of Dr. Nimal Gunatilleke, a house near a small stretch of marshy forest, perhaps the last area of lowland marshy forest, where *Stemonoporus moonii* was rediscovered, a new Vatica and the last wild tree of *Mesua stylosa*.

The former President of Sri Lanka, Dr. Jayawardena, permitted us to collect on his private Estate and offered hospitality at his home. We appreciated this tremendously, together with his willingness to help to preserve endangered species.

We also express our gratitude to Miss Siti Rohajawati, who took care of the typing.

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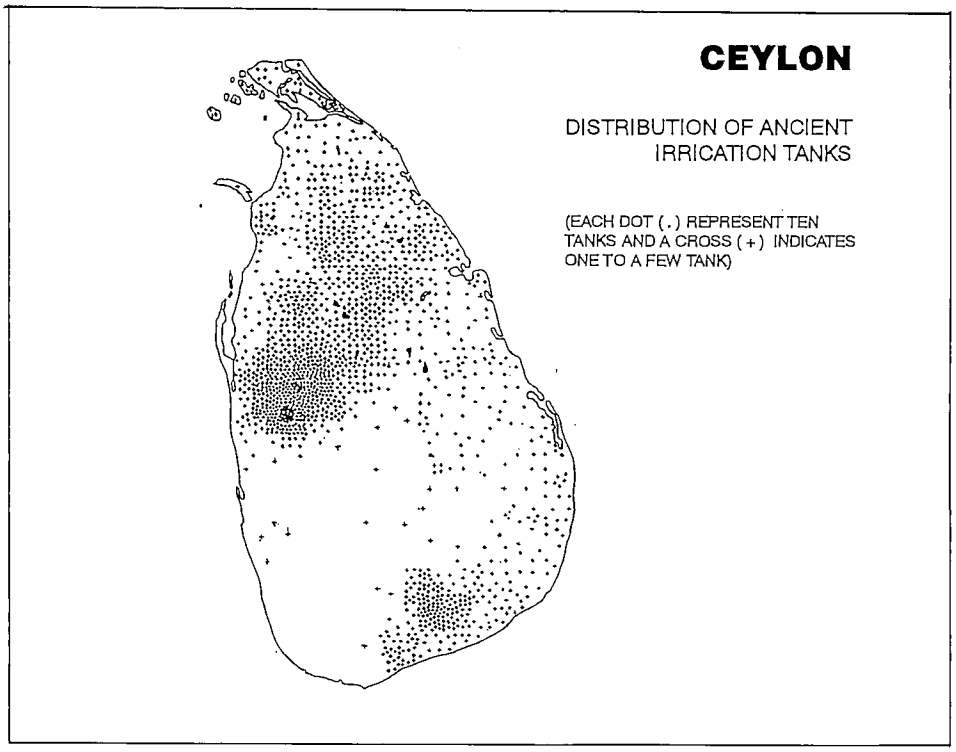
INTRODUCTION

General. Sri Lanka lies between longitudes of N. 79° 39′ and 81° 53′ and latitudes N. 5° 54′ and 5° 52′. The island is pear shaped and covers an area of 25.332 square miles (65610 square kilometers), with a maximum length and breadth of approximately 270 and 140 miles and with a population of 16 million (1984) rapidly increasing population.

It is connected to India by a continental (Deccan) shelf and separated from it in the north by the shallow Palk Strait and the Gulf of Mannar.



Distribution of former irrigation tanks. Abeywickrama (1955)

History. About 2000 years ago Sinhalese and Tamils moved into the island and in the lowlands (Dry Zone) forests were cleared for rice cultivation. The extent may be gleaned from the number of man-made water reservoirs (called tanks), mainly found in the Dry Zone. They indicate that the original vegetation was destroyed. In the thirteenth century the population died out (for unknown reasons, perhaps diseases like malaria or starvation) and a secondary Dry Zone vegetation established itself, much poorer in species than the original one. Many species could have survived because of the habit of Budhists to create sanctuaries near places of worship. Even nowadays there is an enormous difference between areas of Islamic villages, where Nature has been exterminated and Budhist dominated regions.

The Mid-mountains were also fairly densely populated, as may be seen from the presence of tanks.

The coastal areas were colonized by the Portuguese between 1600 and 1650. The colonizers mixed with the local population and a new section of mixed races, calling themselves Burgers, was created. The Dutch replaced the Portuguese between 1658 and 1796 and these by the British from 1796 to 1948. The British were only successful in subjugating the Kandy Kings in 1815.

The British deforested the upper lands above 1000 m altitude by establishing plantations, first coffee, which had to be replaced by tea because coffee was devastated by *Hemileia vastatrix* and the British became tea drinkers. Cinchona was planted after 1870 but nowadays tea is the only important crop of the highlands. In the lowlands the common tropical crops; rice, rubber, oil palm, etc. are the most important.

Geology. Archaeic rocks of precambrium age (kondhalite and charnokite) cover most of the island. Miocene limestone underlies the Jaffna Peninsula and the northwestern coastal regions, Jurassic deposits occur in two small pockets in Tabbova and Andigama and Pleistocene and subrecent gravels are the eastern margins of the Miocene limestone belt.

According to modern assumptions the so-called Deccan Peninsula, of which Sri Lanka and southern India are parts were originally part of the vast continent Gondwana land together with Africa and Australia. The Deccan Plate, together with the Mascarene Plate separated from Gondwana land in the Lower Cretaceous, about 120 million years ago.

Having moved together until about 95 million years ago, the Madagascar and Seychelles plate separated from the Deccan plate in Late Cretaceous or in early Palaeocene about 65 million years ago. After that the Deccan plate moved northwards, not connected with neighboring continents until it collided with the Southern Laurasian plate in the Eocene about 45 million years ago.

Since the Cambrium Ceylon has been mostly above sealevel. In the Tertiary areas of the northwest became submerged.

Latosols occur in the lowlands, podsolic loamy soils in the uplands (de Alwis & al., no date).

According to modern conceptions (Adams 1929) there should be three peneplains with average altitudes of 30, 500 and 1500 m (cf Domrös 1976). The lowest peneplain is the largest part of the lowlands from the north to the east and the southeast, covering the so-called Dry Zone. The second and third peneplains are the Central Highlands with their metamorphic

precambrium rocks in the southern half of the island and comprise the separate Knuckles Mountains, the Central Massif with the highest mountain, the Pidurutelagala (2524 m) and the Sabaragamuwa and Adam's Peak Mountains in the southwest.

The hills are often very typical presenting the pushed-up waves of non-solidified material, the waves broken at their top, showing a gradual slope at one side and of a broken perpendicular wall at the other side. The direction of the pressure easy to see.

Palaeontology. A review is found in Lakhampal (1974). Fossil woods were found in E. Asia and Africa; the latter might belong to Monotaceae, not to Dipterocarpaceae. Fossil woods of Cretaceous age were even found in North America and England, but most palaeontologists consider these to be doubtful. Some fruit from the Miocene or Oligicene from Budapest was identified as dipterocarpaceous, but this seems very doubtful. The only reliable find was a fruit from Sumatra, called by Heer (1874, 1883) *Dipterocarpus verbeekianus.* It is of quaternary age. Fossil Tertiary wood is claimed from Sumatra and West Java (Den Berger 1923, 1927). Den Berger even pretended that he could identify it up to generic level. Whether genera in our modern circumscription were existing already is extremely doubtful. Schweitzer (1959) found what he thought was *Shoreoxylon* in the Island of Timor in S.E. Indonesia, where Shorea does not occur now. No fossil wood ascribed (with doubt) to Dipterocarpaceae is older than the Miocene.

Leaf impressions, ascribed to fossil Dipterocarpaceae are all inventions of fantasy. The well known specialist Dr. Ashton, mistook a full leafy branch with remnants of flowers (*Stemonoporus moonii*) in Ceylon for a Sterculiaceae, Euphorbiaceae, etc.

If it is already impossible to ascribe a leafy branch to the family, the identification of leaf impressions should all be referred to the realm of fantasy.

Fossil pollen were studied by J. Muller (1964, 1970). The drawback of pollen is, that the thin walls do not preserve well and that a distinctive sculpturing is missing. Nevertheless he claimed to have identified pollen of *Dipterocarpus* and *Dryobalanops* of the Oligocene and Miocene of Brunei (Borneo).

For a rather more optimistic review as to reliability see Ashton, 1982, page 242.

Corner (1981): "The whole history of the Angiosperms is still a mystery. Where, when and in what manner they arose is not known. The fossil record has not supplied answers and hence we have to rely on inferences and deductions made from comparison of the living and validity of the conclusions and generalizations cannot be guaranteed. We do not know where dipterocarps come from, and how they dispersed. We can only speculate about their relationship with other families (Theaceae, Guttiferae, Tiliaceae, etc) and there is no consensus. Of the recent genera we are not in the position to say which are the primitive and which are the more developed ones. Cladistics are useless as there methodology is based on simplification subjective weighting of characters and numerous assumptions that have no scientific base. Development of characters is not synchronic, species may be antique in one and developed in other characters; we do not know anything about fossil, extinct genera, about hybridization, not even about monophyly

or polyphyletic issues. That dipterocarps should be spread from the remnants of Gondwana land (Ceylon) to Malesia is pure guesswork.

Dipterocarpaceae form a very closely knit family. The shape of the stamens is without exceptions the same in all genera (and different from the African and American Monotaceae). *Stemonoporus* is no exception. Their anthers are not different from those of other dipterocarps; they are not monoporous and the name *Monoporandra* is a misnomer.

Climate. From May to September the southwest monsoon brings rain in the southwest with highest precipitations on the windside of the slopes of the hills. The northeast monsoon brings mainly rain to the other parts of the island. During the intermediate periods rains come down with thunder by rising warm air. The rainfall in the southwestern region and the Central highlands ranges from 75–200 inches per annum. In the plains the rainfall is more seasonal and there is a prolonged dry season, the major parts have 50–75 inches per annum. This is the Dry Zone area, of which the northwest and southeast areas form the Arid Zone with 25–50 inches annually.

The southwest monsoon is characterized by strong winds, often gale like. These influence strongly the physiognomy of the vegetation in exposed areas. Cyclones occur, but are not very common, although they are devastating (see Dittus 1985).

The average temperature is the lowlands is about 23–24° C. On the highest mountains sometimes ground frost occurs. Humidity in high in the Wet Zone and during the rainy season in the Dry Zone, annual average between 80 and 85%.

Chemistry. (Hegnauer in Ashton in Flora Malesiana 9(2): 273. 1982). Most species have oleoresins (balms, resins). Their volatile portion consists mainly of sesquiterpenes such as humilenes, caryophyllenes, copaenes elements and guajenes (e.g. gurjenene, apitonene).

The sesquiterpene alcohol spathulenol occurs in balms of many species of Shorea (Bisset & al. 1971). The resin fractions of the oleoresins are compounds of triterpenoids and usually consist of neutral and acid components.

Dipterocarpol (= hydroxydammara dienone — II) is a ketonic tetracyclic triterpene alcohol, having the so-called dammarane skeleton, together with similar compounds like dryobalanone it represents an outstanding feature.

The dammarane skeleton is also present in a number of acidic resin constituents such as dipterocarpolic acid, dammaranerolic acid (I) and shoreic acid (II). Other dipterocarpaceous resins triterpenoids possess the pentacyclic skeleton of ursolic acid and (e.g. ursonic acid and asiatic acid, and the lactonic compound B (III) etc), oleanolic acid (e.g. oleanolic acid, hederagenin etc.) and betuline acid (e.g. erythrodiol). Compound I, II and III have an oxidatively cleaved A-ring, they represent the socalled A-ring seco-triterpenes, which seem to be the rather characteristic of dipterocarps.

Some attention has been paid to the phenolic constituents of leaves, barks and seeds. Dipterocarps tend to produce proanthocyanidins (e.g. oligomeric cathechins, formerly called leucoanthocyanidin) and gallic acid derivates. These polyphenolic compounds are building stones of condensed and hydrolysable tannins, both types of tannins are present in species characteristic ratios and amount in many species.

Two derivations of gallic acid must be mentioned ellagic acid and, the dilactone formed in hydrolysis of ellagitannins in leaves and seeds and bergenin, a derivated of gallic acid and occuring in *Shorea*, *Stemonoporus* and *Vateria* (Bihrara & Seshadri 1966; Desai & al. 1967, 1971; Bandharanayake & al. 1977). Both compounds may represent good chemical characteristics of dipterocarps.

The same may be true for *Hopea* phenol, a phenolic constituent of bark and heartwoods, known from species of *Balanocarpus*, *Hopea* and *Shorea* (Coggon & al. 1965, 1966; Maddhay & al. 1967).

Hopea phenol is a condensation product of four molecules of the trihydroxystilbene resverratrol, chemically similar to the viniferine-type of phytoalexins of *Vitis vinifera*.

As to phenolic leaf constituents, Bate-Smit and Whitmore (Hegnauer 1966) pointed out the frequent occurrence of vicinal tryhydroxyxylaion (ellagic acid, gallic acid, B-ring in the flavovoids myricetin and prodelphinidin.

Seed fats (oils) of dipterocarps are characterized by strong dominance of stearid and oleic acid. The composition of the oleoresins (sesquiterpene-fractions, triterpene). See also Wickramasinghe & al., Phytochemistry 16: 700. 1977.

Distribution. Since the sub family Monotoideae has been separated from the Dipterocarpaceae as a proper family Monotaceae, the Dipterocarpaceae are restricted to tropical Asia (one exception: *Vateriopsis* in the Seychelles) with 14 genera and ca 470 species (Ashton) from India through Bangladesh, Burma, S. China, Thailand and Indochina to Malesia (Malaysia, Indonesia, Philippines, New Guinea) up to the Entrecosteaux Islands.

They do not occur in New Britain and New Ireland and in Indonesia they go eastwards no farther then West Sumbawa of the Lesser Sunda island. In the mountains of West Sumbawa a peculiar forest of gregarious *Dipterocarpus retusus* is found, of which the emergent trees are those of *Serianthes minahassae*, towering high above the dipterocarp forest. How *Vateriopsis* came to the Seychelles is not known; suggestions of plate tectonic movements have been put forward; I believe that human transportation possibility should not be excluded.

Sri Lanka has 9 genera, with 58 species of which *Doona* and *Stemonoporus* are endemic. The non-endemic genera *Dipterocarpus*, *Vatica*, *Hopea*, *Sunaptea*, *Balanocarpus* occur in the entire distributional area of the family. The genus *Balanocarpus* is now restricted to South India and Ceylon, those of Asia have been referred to *Hopea* and *Shorea*, except one, *B. heimii* for which a new genus *Neobalanocarpus* was created.

The genera *Dryobalanops*, *Anisoptera* and *Parashorea* are absent.

There are no disjunctions in the genera, the one of *Cotylelobium* is eliminated by fusing *Cotylelobium* with *Sunaptea*.

Of the species of Sri Lanka all are endemic. Endemism is equally very high in Southeast Asian species.

Dispersal. The winged fruit is only effective in wind dispersal at high wind velocities, which are rare in tropical rainforest in most areas, but should be sufficient in the secular life of the trees to induce proper disposal of long distances.

Normally the heavy fruit of Dipterocarpus species become entangled by

their wings in the underbrush and dies (in gregarious species without underbrush this is different). The fallen fruit, if not already infested by beetles on the tree, are apprehended by the very common wild boar and termites. That only mast years should improve chances of survival, is in general not true; a few fruit under a tree does attract less or no predators, which is proved by the number of present seedlings.

The leaves of *Dipterocarpus* species often deteriorate very slowly and seeds fallen on the litter usually dry out and have little chance of survival.

For proper growth ecto mycorrhiza should be present. These fungi are not dipterocarp specific ones. During the dry season the spores from their carpophores are widely dispersed by many vectors and obstacles like rivulets form no obstacles, as was suggested by Ashton.

Sometimes winged fruit are distributed by water in riverine species. Wingless fruit are usually dispersed by water.

In *Stemonoporus* fruit setting is often poor, the unripe fruit drop easily, when disturbed and the fallen mature fruit must have much water. This is perhaps one of the reasons that seedlings are so scarce and enlarging of the areas of the species is so slow or non-extant.

Reproductive biology. It is often assumed that flowering does not occur annually, but as a plant collector I have always found a tree which was out of step and flowered, whereas the bulk remained flowerless.

The heavy flowering of dipterocarps in some years attracted much attention, too much, as it obscured that the fact that general profuse flowering is characteristic of most tropical trees, but it less conspicuous, because they are often not the dominants.

Mass flowering occurs after a severe dry season and is caused by water stress. It is amazing that this simple statement has not been understood by ecologists, however, it is well known by horticulturists who use waterstress to improve flowering, by girdling trunks, cutting roots, defoliation, lowering the water table as carried on in citriculture in coastal areas of Thailand, etc. Although flowering is induced by water stress, every species and also the same species in other habitats flower at different times, when there is severe water stress; these categories flower more simultaneously.

The cause of the actual anthesis when the flower buds are mature, is unknown, but might be a drop in temperature, as proved, long ago in the cae of *Dendrobium crumenatum.*

About the usefulness of mast fruiting in dipterocarps much has been written, but always from the anthropocentric angle. There is not such a thing as economy in nature, a fictitious idea, invented by Man. In all plant families there is always a waste of flowers and fruit and even the human race follows this principle, demonstrated by over population. An example of mass flowering after a very dry season, may be seen along the road to Mahiyangane in the Knuckles, where Myrtaceae abound and form part of the canopy.

Pollination is carried out by bees, in Malesia *Melipona* stingless minute bees, by moths and butterflies and beetles. Thrips are assumed to play an important role (Appanah & Chan 1981).

Actually very little is known, mostly it is speculation.

Fruit are often already attacked by parasites (beetles) in the flowering stage. Fruit setting after enormous flowering is often poor; this holds true for

all tropical trees, but this does not mean anything; a tree that lives 100–200 years needs only one or two fruit developing to maintain itself.

Morphology. *Roots.* Stiltroots are not represented in Ceylonese dipterocarps. Roots are superficial and trees prone to wind fall. Boles of genera of *Shorea, Doona, Dipterocarpus* are long straight and cylindrical. In *Vatica* more irregular. Here there are always hoop rings. Crooked boles are found in Asia in dipterocarp species of the seasonal zone. In Sri Lanka it is known only from *Balanocarpus brevipetiolaris* which grows on a rocky ridge with little soil and water stress. I have called this Bonsai effect. This Bonsai effect disappears on deeper soils without water stress. Dipterocarps belong as a rule to the group of large trees with sometimes of enormous bole diameters. Smaller trees are found in *Vatica, Hopea, Balanocarpus,* etc. The smallest trees are found in *Stemonoporus* with stem diameters of a few cm, causing flopping over of the trees if there is no support. In flopped-over trees the side branches become negative geotropical and new erect stems develope.

Buttresses of all kinds are found, flying buttresses are found in some large tree species. Sometimes buttresses are rounded, small and inconspicuous, like in *Vatica*; in *Dipterocarpus* they are lacking, although the trees are huge. Whether this is compensated by deep-rooting is not known.

Suckering from stumps is found in dipterocarps of seasonal areas and in Bonsai types; in such species epicormic shoots are often common.

Seedlings have one or more pairs of opposite leaves, followed by spirally arranged ones. The leaves are usually distichous on plagiotropic branches.

Sapling leaders and stems initially grow continuously, but after some years a resting period—often of several years— sets in. During this period many saplings die. Internodes are often longer towards the beginning of the growth flush, resulting in aggregate leaves and pagoda like crowns. Typical for many *Shorea* species are very open crowns with long, bare branches, bearing numerous branches only at their ends.

There are two types of branching, one with a continuous growth and one with a rhythmic growth.

Small trees remain monopodial with narrow conical crowns. In large trees, when they reach the canopy, the branches become orthotropic and the leaves become more erect.

In bad soils seedlings may lack roothairs, but are enveloped completely by ecto-mycorrhiza mycelium. They hardly grow and may remain small for considerable periods.

For more information see Ashton (1982).

Buds. The resting bud is covered by bud scales. In young shoots wasps sometimes cause peculaliar very large, globose galls covered with imbricate scales (found in one species: of *Doona* in Ceylon). These galls have no taxonomic value.

Leaf. Twigs are often enlarged apically. Leaf stipules, either very small or very large are mostly fugaceous but may be subpersistent in *Dipterocarpus.*

Type of nervation can be used diagnostically but it is overemphasized by Ashton, who gives it a higher weighting than fruit characters, as a result of the policy in the Malay Peninsula, where forest personnel has to identify species by characters of fallen leaves. Hence I have included *Cotylelobium* in Sunaptea. Ashton is not consistent in applying nervation characters, as in Hopea there is a dryobalanoid nervation.

Domatia occur in several genera and are often very conspicuous in seedlings and young saplings, they are glabrous, large or small or very hairy and are found sometimes along the midrib from base to apex and even along the bases of lateral nerves, they are species-diagnostic.

Extrafloral nectaria occur in many genera on the upper leaf surface, often along the margins.

The petiole is always more or less tumid apically.

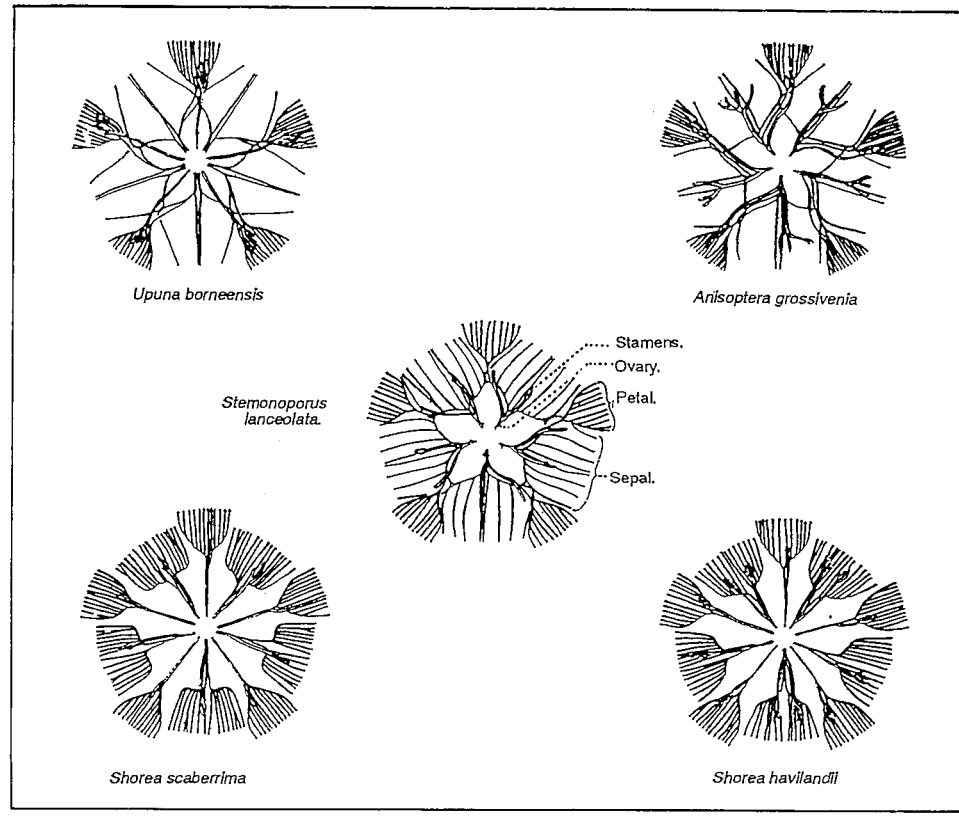
For the anatomy of the epidermis see Maury's thesis. Genera may be sometimes recognized by leaf anatomy, species not.

There are long stalked glandular hairs (also in *Monotes*) among the short stalked ones with multicellular head, the stalk base is sunken into a pit. Unicellular hairs are omnipresent. Unicellular papillae occur on the ovary, stylopodium and connectival appendages of some species.

Wax secretion, shaped like scales is common. Stellate hairs are the most common ones with either hairs of equal length or with some hairs longer and stiff causing scabricity.

Inflorescence. Typical are the semi-pendulous, bracteate, apical, axillary or ramiflorous panicles, once or twice branched with the flowers second and nodding, developing flowers acropetaly. The flowers of *Vatica* and *Vateria* are not secund. The panicles are from multi-flowered to reduced to a single flower.

Flower. The centrifugal stamens originate from a number of common bundles, independent of the ovary. Modes of vascularisation may be gleaned from fig. 11 of Ashton's 1982 review.



Floral vascular supplies. After Ashton 1982

The stamens are very uniform, especially the narrow triangular flattened filaments, hair thin at the anther attachment or very uniform and very different from those of Monotaceae. The anthers are either two-or 4-celled, and dehisce by longitudinal slits, also in the genus *Stemonoporus*, which has been erroneously described as monoporous.

The number of stamens can be used only exceptionally for delimitation of genera. The base of the style is sometimes thickened into a stylopodium. The stigma is as a rule small, except in *Vatica* where it is tri-lobed and often cup-like. Connectival appendages are a characteristic feature in dipterocarps. They are an extension of the filament on the back of the anther, often highly coloured. They are either filiform, branched or not or thick and short. These differences can be used to recognize different genera.

Fruit. The accresent fruit calyx may have a tube-like basal part, sometimes adnate to the ovary. Usually the lobes are free, except the utmost base, imbricate in bud, after enlarging becoming valvate or vice-versa. This character is not very clearly expressed.

The development of the calyx lobes is one of the main bases on which dipterocarp genera are founded. In many genera they grow out into upright wings, often characterized by a typical venation. Usually the wing like sepals are of different length.

In *Hopea* only two become wing like, the remainder remains short; in *Shorea* there are three wings. However, within these genera there are sections without wings.

The wings are as a rule thickened at their base, but not all of them (distinction between *Hopea* and *Shorea*, where one has the outer, the other the inner wings with a thickened base). In *Vatica* many types of calyx development are found and I have started to re-instate genera, like *Sunaptea* with well-developed erect wings, free at their base, of slightly unequal size. According to Maury, who accepted *Sunaptea*, this genus is quite distinct from the remainder of *Vatica*. I agree also with her, that *Pachynocarpus* should be re-instated. If the two genera mentioned above are expelled from *Vatica*, the remainder is characterized by somewhat enlarged sepals, usually thin and either adpressed to the fruit base or patent and a section with hardened, narrowed sepals pointing downward.

The base of the fruit wings in *Sunaptea* is not uniform, some species have a flat fruit plate, to which the narrow bases of the wings are attached. Whether this is a character at the generic level, has to be investigated.

The actual fruit bursts at the top to release the radicle at germination or splits into three valves or the epicarp tears irregularly. In *Stemonoporus* irregular tearing and valvate dehiscence both occur and Maury identified for them two sections (*Stemonoporus "ronds"* and *Stemonoporus "ovoides"*). This sub-division does not co-incide with the subdivision accepted by us, based on the number of stamens (section or sub-genus *Stemonoporus* and *Monoporandra*).

The fruiting calyx in the genus *Dipterocarpus* is sometimes longitudinally ribbed or winged. In *D. zeylanicus* both smooth and winged tubes are present.

Embryology and germination. Only one ovule developes (Rao 1953, 1956). Embryo development is of the polygonum type. The endosperm is initially free nuclear.

Fruit may be poly-embryonic. Maury (1978) described the shape of many embryos, showing a great variation even in the same species.

The cotyledons are large, unequal or sub-equal. In *Doona* one is large and ruminate and remains in the pericarp at germination, the other small and leafy and photosynthetic.

Sometimes one cotyledon is folded around the other.

In *Dipterocarpus* and *Stemonoporus* both cotyledons are ruminated, folded and remain in the pericarp, the embryo freeing itself by elongation of the cotyledonary petioles. In some *Vatica*, in *Sunaptea* and in *Stemonoporus* the cotyledons are laciniate.

As a rule the embryo remains small until immediately before germination, when the radicle elongates rapidly, bursting through the fruit apex and splitting the fruit irregularly or regularly in 3 valves (*Vatica*, some *Stemonoporus*).

In normal position the fruit lays length wise on the forest floor, the growing radicle turns and grows upwards and only later turns down, there is a risk of drying out and hence planting should be carried out by cutting off the wings and pressing the cut end in the ground: the radicle goes then straight down.

The first leaves are usually opposite and much larger with many more ribs then the leaves of a mature tree; the stipules are larger and persist longer and like in all forest trees, there is a drip point.

Seedlings may be sometimes recognized specifically; the position of the hypocotyl is characteristic.

For more information see Maury (1978) and Ashton (1982, p. 263-266).

Anatomy. Vestured pits and tyloses are omnipresent. The lateral (and also apical in *Stemonoporus*) leaf traces separate from the central vascular cylinder well below the node, passing through the bark before entering the petiole, sometimes (in *Dryobalanops*) even at or before the previous node.

Vertical intercellular resin ducts, scattered or in arcs, are universal and occur in the pith of internodes and leaf traces.

The wood anatomy has been studied extensively by Gottwald and Parameswaran and before them by Desch. Valuable taxonomic characters are found in vessels grouped or solitary, in uniseriate or stored rays, scattered resin ducts or in tangential bands or in medullary rays, thick-walled fibres or thin-walled; fibres with bordered pits.

The petiole anatomy of seedling plants were extensively studied by Maury (1978). Ashton found that the variability in a single species was so high, that petiole anatomy cannot be used for taxonomical purposes (after Ashton 1982, p. 267–268, reference list).

Pests and diseases. Major pests of dipterocarp seeds are weevils of the genera *Akidodes* and *Nothophyes* in Malaysia. They do not show any host specificity.

Other pests are microlepidoptera belonging to the families Pyralidae and Tortricidae and the Scolytid beetles belonging to *Poecilopsis*. Furthermore a number of hymenopyteran parasites belonging to the families Braconidae and Ichneumonidae.

Their role in pollination has not been investigated.

(K. Daljeet-Singh, Seed pests of some dipterocarps, The Malaysian Forester 37(1): 24–36. 1974).

Silviculture. Basically there are two ways of exploiting a tropical forest : 1. clearcutting and replanting and 2 selective felling.

Interference in a tropical forest, however small will change the forest and hence it makes no sense, what foresters have tried to maintain, that the original forest could be conserved, when trees are extracted.

Many years went by, especially in the Malay Peninsula with experimenting how to exploit the tropical forest. After many trials mostly adopted is the Malayan Uniform System, consisting of a single felling followed by more or less vigorous poisoning of undesirable species to improve light conditions for the preserved species, springing up naturally. This system changes the forest completely but is accepted because it is cheaper than clear felling and planting. In Indonesia the systems of selective logging is advertised. Logging companies pay a fee for replanting, but there has never been control, the money for replanting disappeared and the forests are finished. After years of mismanagement with rampant corruption the end is everywhere the same; first the export of logs is forbidden in order to keep the timber for inland industries, then timber is introduced and the governments try to establish timber estates, but over cutting of virgin forests that is left goes on and the end will be a collapse of the timber industry. There are also trials to create forest estates by planting cuttings of dipterocarps, but as dipterocarps are no pioneers, the young plants are decimated by lack of water and by fires. So far results are minimal. Interplanting in depleted, logged-over forests are carried out on a small scale. The future for creating forest estates of dipterocarps does not look promising, weed trees with a high growth rate will replace them.

As like in almost all tropical trees ectomycorrhiza on the roots are necessary, there is now care to take notice of this when making nurseries of cuttings.

Large scale cutting of the Sinharaja forest with help of the Canadian government under the auspices of the Colombo plan, proved to be uneconomic and was abandoned also by pressure of the citizens, who wanted to stop the wholesale destruction of nature to get some temporary gain by a few people. Logging still goes on in the Kanneliya forest to feed a huge plywood plant. There is little forest left and population explosion, like in all undeveloped countries will accelerate the disappearance of tropical forest. The often used comparison with temperate zones, where the forest has been destroyed, is a fallacy. In temperate zones there are practically no heavy rain showers which cause erosion and washing out of nutrients.

Most dipterocarps are light demanding except the younger stage, which needs shade; seeds are found in abundance almost annually with occasional mast years of over-abundance.

The xerophytes (not in Sri Lanka) produce a hardy, stout root systems, the seedlings survive fires. Those of the non seasonal rainforest are killed by fire.

HISTORY OF THE TAXONOMY

Marco Polo was perhaps the first who mentioned a dipterocarp species (*Dryobalanops sumatrensis* (Gmelin) Kosterm., synonym *Dr. aromatica* Gaertn. f.), when visiting Fansur in N.W. Sumatra. This famous tree, yielding so-called Baros camphor (different from the real Japanese camphor from *Cinnamomum camphora*), a product worth its weight in gold at that time, was mentioned many times in pre-Linnean papers (cf. Kostermans, Blumea 33: 341. 1988).

Rumphius in 1741 in his Herbarium Amboinense, mentioned Arbor Koring, which represents a species of *Dipterocarpus*, called Kru-ing in Kalimantan Borneo. Linnaeus described already in 1737 *Vateria* from India, believed by him to be related to *Mesua* in Clusiaceae and also near *Tilia* and *Microcos* in Tiliaceae. This is still considered to represent the affinities of Dipterocarpaceae. The genus *Vatica* was described by him in 1771, but the type species *Vatica chinensis*, is still a puzzle, and might or might not be from China.

In 1824 A.P. de Candolle placed *Vatica* in Tiliaceae (he did not mention *Vateria*). Gaertner created the genera *Dipterocarpus*, *Dryobalanops* and *Shorea*, based on seeds and fruits and maintained relationship with Tiliaceae.

Ultimately Blume established in 1825 the family Dipterocarpeae, considering it related to Tiliaceae and Clusiaceae.

Bentham and Hooker (1862) left the Dipterocarpeae in Guttiferales, but considered it related to Tiliaceae and Ternstroemiaceae.

The first overview of the family was presented by A. de Candolle in 1858 in the Prodromus, more than a century after Linnaeus. He included the African genus *Monotes*, but stressed its isolated place in Dipterocarpaceae.

A continuous flow of revisions of parts of the family appeared after this. Dyer revised the species of India. Burck (1887) made an overview of the East Indian species, based on anatomical characters and because of this reached different conclusions. He was followed by Heim in 1892 in France, who for lack of adequate material made several mistakes, like *Cotylelobiopsis*, based

on a sterile shoot, which ultimately proved to be *Pseudosindora* in Leguminosae.

In 1895 Dipterocarpaceae appeared in Engler & Prantl, Natürliche Pflanzenfamilien, written by Brandis and Gilg. They reduced many of Heim's genera and accepted the system of de Candolle. The genus *Monotes*, expelled by Heim, was re-included in the family.

From 1927 to 1957 until his death the Malesian Dipterocarpaceae were revised by D.F. van Slooten in the Herbarium Bogoriense. In *Vatica* he created in 1942 the sub-section *Keramides*, which is a *Mesua* species in Clusiaceae.

In 1978 appeared the Thesis of Mrs. Gema Maury-Lechon, a voluminous work dealing with the anatomy and embryology of many Dipterocarpaceae. She presented a new classification (volume 1 B: 371). The order of Dipterocarpales is sub-divided into two families: *Monotaceae*, comprising two sub-families: *Monotoideae* and *Pakaraimoideae* and the family Dipterocarpaceae, comprising two sub-families: *Imbricoideae* and *Valvoideae*. As the family *Monotaceae* was not described according to the Rules of Nomenclature, I had to remedy this matter (Kostermans, Taxon 38: 123. 1989).

Maury maintained the genera *Doona* Thw., *Sunaptea* Griff. and *Vateriopsis* Heim.

In 1982 appeared Ashton's treatise of Malesian Dipterocarpaceae in Flora Malesiana Ser. I. 9(2). He sub-divided the family into three sub-families: *Dipterocarpoideae* (Old World), *Monotoideae* (Africa) and *Pakaraimoideae* (New World). The work of Maury is not mentioned.

I believe, that I have demonstrated convincingly that Maury was right and that Monotoideae from Africa and Pakaraimoideae from America represent a family different from Asian Dipterocarpaceae (Kostermans, Taxon 34: 426. 1985).

Ashton's opus magnus was severely criticized by Kochummen of the Forest Research Institute, Kepong, in a typescript, 8 page paper sent to the main international Herbaria.

Unluckily these corrections and emendations have not been published in Addenda of Flora Malesiana, as usually done for other families, for obvious reasons. Apparently van Steenis, the editor, accepted Ashton's paper at face value. We hope that the omission will be rectified as it will only improve Ashton's paper, which is the base for future research.

The Sri Lanka history, apart from a note on *Vateria* by Linnaeus in 1747 (Flora Zeylanica), started with Thwaites's book Enumeratio Plantarum zeylaniae (1859 and 1864). Thwaites created three endemic genera: *Doona*, *Stemonoporus* and *Monoporandra*. He described most of the known endemic species. The sole species of *Vateria* was called *V. indica* L. Blume (Mus. Bot. Lugd. bat. 2: 29. 1851) had made two species of *Vateria indica* L., reserving the specific epithet for the Ceylon species and naming the Indian one *V. malabarica*. Part 5 (the last one) of Thwaites's book was published in 1864; it contains the Addendum (pages 402-405) where *Stemonoporus* was included in *Vateria* and *Isauxis* in *Vatica*, under the influence of Hooker.

The Dipterocarpaceae were treated by Trimen in volume I (1893) of his Handbook to the Flora of Ceylon. He again separated *Stemonoporus* from *Vateria* and recognized *Doona* and *Balanocarpus*. Alston produced a supplement to Trimen's Flora (volume 6) in 1931. The sole species of *Vateria*

was called *V. copallifera* (Retzius) Alston, based on material, collected by König in Ceylon. The type material in Lund is not absolutely established as the type species as it bears no annotation. Alston included *Monoporandra* Thw. in *Stemonoporus*, which has not been contested afterwards.

A revised edition of Trimen's Flora under the editorship of Fosberg and Dassanayake is in the making. Volume I, of which part 2 contains the Dipterocarpaceae of Ashton was printed in Ceylon in 1977, but because of difficulties, financial and others, the printing of the Revised Flora was moved to New Delhi and the Ceylonese volume I reprinted verbatim as volume I of the New Delhi series in 1980.

Ashton reduced *Doona* to a section of *Shorea* and included *Balanocarpus* in *Hopea*. In *Stemonoporus* he failed to recognize *St. moonii* Thw., based on a semi-sterile branch, which he mistook for a species of Sterculiaceae or Euphorbiaceae.

During a two years stay in Sri Lanka as a visiting professor of the Peradeniya university, I have been able to bring together one of the largest one-man collections of plants of the island (c. 6000 field numbers) and encountering difficulties in identification, decided to revise completely Myrtaceae (Kostermans, Quarterly J. Taiwan Museum 34: 117–188. 1981) and Dipterocarpaceae (*Balanocarpus* in Bull. Museum nation. Hist. nat. Paris, 4e Ser., Sect. *B. Adansonia* 2: 173–179. 1981; *Vatica* in Reinwardtia 10: 69–79. 1982; *Hopea* in Ceylon J. Sci., Biol. Sci. 15: 41–49. 1982; *Shorea* in Botan. Jahrb. Syst. Berlin 104: 183– 201. 1983; *Doona* in idem 104: 425–454. 1984; *Sunaptea* and *Cotylelobium* in Proceed. Third Round Table Conference Dipterocarpaceae, Samarinda 1985: 605–627. 1987).

ECOLOGY AND VEGETATION CLASSIFICATION

The vegetation and its classification, have attracted many people, initially foresters and geographers (a.o. Rosayro and Holmes) and geographers (a.o. Gaussen et al.), who published rather superficial papers on a classification, based on physiognomy; later plant ecologists (a.o. the Gunatillekes) started more detailed work.

Perera (1975) discussed the different classifications, whereas Greller & Balasubramaniam (1980) presented an overview of vegetational types and added some new ones. Koelmeyer (1957) and Gaussen & al. (1964) started with using more precise names for vegetation types, based on plant species.

From existing publications, the conclusion can be derived, that no proper, uniform and generally accepted classification has been established.

Originally (and still in force) classification of the vegetation was based on physiognomy (Champion in India), but physiognomy is an improper parameter, as it is not constant. A vegetation may one year be deciduous, another year with more rainfall semideciduous and even be semideciduous-evergreen.

Remote sensing techniques are also based on physiognomy and were hence only successful in recognizing special, well marked vegetations, like mangrove (provided that the locality was known) but failed utterly in subdividing the components of the tall tropical climax forest (on purpose I delete the word rain, as it is superfluous).

The same is true of the work of ecologists. Hundreds of plots have been investigated in the Asiatic tropics with information on number of trees, the size classes, the basic area, the number of species, etc. But the next step is failing, because it needs knowledge of the species. In the plots scrappy, mostly hardly or not identifiable material was collected which was identified by others and in the plots the ecologists were dependent on local people for identification. As a result they never learned anything about the species; the building stones of the vegetation and the identifications are less trustworthy than they should be.

A combination of a taxonimist-ecologist is hard to find. And after all : Is it worth the endeavour in view of the total demise of the tropical forest?

Fosberg (Trop. Ecology 18: 97) severely criticized ecological work.

Another difficulty for the ecologist is how to reconstruct the original vegetation, before the interference of Man.

In Sri Lanka the so-called Dry Zone vegetation area is a typical example. At the advent of the Sinhala people, 2000 years ago, the then existing vegetation (assumed to be the climax at that time) was completely eradicated, to be replaced by irrigated arable land; irrigation accomplished by using natural ponds and creating hundreds of new ones (so-called tanks), Budhists have the habit of preserving vegetation near their sanctuaries, usually rocky places with caves, contrarily to Moslims (still to be observed nowadays: in Moslim areas Nature has been exterminated). Together with untouched pockets of vegetation near hilly outcrops (Ritigalle, Friars Head, etc.) many species survived and were able to re-aforestate the Dry Zone when about 1500 the population died out (reasons unknown, perhaps diseases and famine). This secundary forest reached its climax and is relatively well studied (more easy to work, than the aseasonal lowland forest). An intensive survey was carried out by Muller Dombois in the Ruhuna National Park in the northwest.

The Mahaweli Project will again destroy this Dryland forest, except for some pockets.

It is now well known, that tropical (and other) forests consist of a patchwork of series or associations of species, small patches and large patches, some not more than some square meters with one or a few species, to large ones with tens or hundreds of species. Hence it is nonsense to try to estimate the so-called minimum area of a certain patch (association), as this depends completely on the site.

We also know now, that the patches are not constant in species content (at least not in general) and change in time, secular and in geological times, by means of gaps, caused by fallen trees, the gaps than filled up with seedlings already present, or present as propagules in the soil bank or from surrounding trees, that happened to have mature propagules at that time. When the gaps were not too large, the refilling was not much different from the original composition, if the gap was large, an intermediate, temporary vegetation of secondary forest trees developed, making place later for the high forest climax trees. To know something about this needs a thorough knowledge of secondary forest trees, which may continue for a long time as massive trees and may deceive the ecologist, who does not know them.

Gap renewal is not general; in the Dry Zone vegetation replacement is performed in another way.

How this patchwork or mosaic started is unknown, it is assumed to be based on chance.

By experience I side with Whitmore contra Ashton, that the main factor to decide the actual species is water, not material content of the soil. An experiment by Gunatilleke in the southwest lowland aseasonal forest on the coincidence of Dipterocarpus hirsutus with mineral rich soil, does not prove anything.

Edaphically bound vegetation, common in tropical southeast Asia, are unknown in Sri Lanka, except for a few, like mangroves, salt marshes, Bonsai vegetation on bare rocks, etc. Peat forest does not exist (a swinging bog was

seen near Bolotuto Pass, the surrounding forest heavily damaged by gem seekers). Mangrove exists, but is not well developed, Roh-humus was found on bare rocks in the Mountain Zone, with a typical association.

For the Knuckles Massif de Rosayro produced a small, not very accurate map of the tens of vegetation types (in reality there are hundreds), associated with distributional rainfall, exposion to sun and wind, etc.

As we are here mainly interested in dipterocarps, the vegetation of the Dry Zone will not be discussed. Only *Vatica* (endemic, local species) occurs in gallery forests, usually with their roots in the water (in the wet season). The patches of existing vegetation have hardly been established, from the *Acacia planifrons* on the island of Mannar, the coastal sandy belt with Diospyros non flowering species and *Eugenia cuminii*, the more inland vegetation of dense pole forest but also of Ebony, of *Diospyros ferrea* together with *D. nummulariifolia* and perhaps a hundred other ones, even a new association was found near Trincomalee behind the Pandanus zone: a low forest of thin trees of Cassine glauca. Much work has to be done, before we know, what series are represented.

There is a consensus, that a Dry Zone vegetation exists in the North, the Northwest, the East and the Southeast, the driest part being the Yala Park in the Southeast, sometimes desertlike, but still with numerous associations. The temperature is high, the number a consecutive dry days per month or year very high.

A special part is the vegetation near Batticaloa, with other endemics (a new *Mimusops* recently found). The area was devastated by a cyclone (cf. Dittus) and the debris burned, which caused the demise of the vegetation.

The Southwest sector of the island has an everwet (aseasonal) tropical lowland forest, its main conserved area the Sinharaja forest (9 per cent of the total island surface). It merges gradually into the Midmountain area, an ill-defined Zone: knowledge of the pertinent species is an absolute must. Arbitrary altitude boundaries, like up to 1000 m (van Steenis) are nonsense, the boundaries may be at 500 or at 2000 m dependent on exposure, rainfall, telescoping effect, etc.

The Mountain Zone is slightly better marked by knowledge of species. Missing is the Summit Zone, occuring on all mountains in tropical Asia with very characteristic endemics. This Summit Zone is usually small in extent and is prone to the effect of irradiation and wind and often drier than the mountain itself.

The lowland tropical aseasonal forest has been worked over by the Gunatillekes, who investigated plots in the Sinharaja forest, a Man and Biosphere area of 11000 ha., of which the western side has been partly selectively logged between 1972 and 1977 by the State Timber Corporation (Canadian Project under the Colombo Plan); after that logging was suspended, as it proved to be uneconomical, logging for the huge plywood plant is still going on in the Hiniduma forest area.

According to the Gunatillekes (1980) there should be 830 endemic species of seedplants in Sri Lanka. They overlooked about 50 species. Most of the endemics are found in the Sinharaja area. These ecologists established three different plot areas, Waturana, Warukandenia and Sinhagalle. From their figures it is clear, that the general rule for tropical forests is applicable, the wettest and most dissected area of Warukandenia, is richest in species, then

follows Waturana, which is slightly drier and the lowest number of species is found on the drier Sinhagalle.

In the Warukandenia area dominant species are belonging mostly to *Doona* (*disticha, macrophylla, trapezifolia*) whereas the sub canopy is dominated by *Cullenia rosayroana*, a.o.

A remarkable fact is that only recently the dominant species of the sub canopy (*Cullenia rosayroana, Garcinia hermonii, Mesua pulchella*, etc.) have been identified.

The vegetation in the Sinharaja forest, is by no means always dominated by dipterocarps, but about the distribution of these associations nothing is known. Koelmeyer and Gaussen & al. were the first to get rid of the term Mixed Dipterocarp forest, where the word Mixed simply means: we do not know. Too much attention has been paid to the dipterocarps to define vegetation types; ultimately it is likely, that species of other families will give a far better description of the different patches. Gaussen coined the *Doona-Cullenia, Mesua* vegetation (more precisely this should be *Doona-Cullenia rosayroana or Garcinia hermonii-Mesua pulchella*). *Mesua pulchella* is an endemic species, easily recognizable by its drooping branches and the dark green lower leaf surface and much smaller flowers. This species often overtops the Doonas (a similar case I found on the island of Sumbawa, where the *Dipterocarpus retusus* forest is overtopped by giant trees of *Serianthes minahassae).*

As was proved in the Waturana area, dipterocarps are not the only dominants, there are several other species of different families.

Mitchell & Tilsikratwana (1980) investigated the bottom vegetation of a dense *Doona* forest near Weddegalle. The flora is very poor on the dark forest floor and consists mainly of saplings of the species of the upper canopy.

In Warukandenia two *Stemonoporus* species were located, one represented by a single tree, the other forming a small population on a very wet slope. In a plot in the Eastern, higher part of Sinharaja the same species occurred, again as a small population on a very wet slope, accompanied by the Dia-na (*Mesua ferrea L.*) that, as its local name indicated is also a dweller of the wettest places.

Stemonoporus is a genus occurring in small patches from the lowlands up to the Mountain area at almost 2000 m. Their patches should not be regarded as a special forest formation, but are simply parts of a mosaic.

On Sinhagalle, a low hill, the summit has a plot of the rare *Loxococcus rupicola* palm and the extremely rare (one plant on a rocky outcriop) of *Atalantia rotundifolia*. There are no dipterocarps.

The Gunatillekes also made sample plots on Haycock Mountain (Hinidumkande) on the more accessible slope (the steep slope will have without doubt other vegetation associations). The Mountain top has *Diospyros oppositifolia*, a few trees, the only place in Sri Lanka and a single specimen of a rare endemic *Schumacheria*. One tree of *Dichilanthe zeylanica* was found, but later this was also observed as a few trees lower down in the Hiniduma forest.

In the Kitulgalle area, other associations are found: a few trees of *Balanocarpus kitulgallensis* and a single tree of *Stemonoporus petiolaris.*

A very small patch of the newly discovered *Dysoxylum peerisii* was found behind the Field Station. Here we found also a single treelet of an

undescribed *Cinnamomum*. The *Cinnamomum sinharajaense* was only found twice along small streamlets. *Calophyllum cordato-oblongum* is restricted to a small patch along a rivulet.

Greller & al. (1980) investigated some areas near Kandy. On the slope above Kandy even the secondary vegetation has disappeared. Contrarily to their conclusions of the vegetation of the Ganuruwa hill, which I explored intensively, the entire vegetation is secondary and badly depleted of species. *Neolitsea* cassia on the top, is one of the most common secundary species of Sri Lanka and hence indicates nothing. So is *Artocarpus*.

The Mountain Zone shows some gregarious vegetational areas of *Doona gardneri* and *D. trapezifolia*. *Stemoporus gardneri* was found on a ridge at the foot of Adamspeak, together with *Palaquium rubiginosum*. This does not mean, that it is always accompanied by Palaquium, the slopes of the ridge have not been explored: plots have to be laid out here.

Again in Kitulgalle area *Hopea jucunda* and *H. modesta* are forming associations not found anywhere else.

There are hundreds of other examples of associations.

The Knuckles Mountains have a different vegetation, because they are drier. The number of associations is innumerable. One *Stemonoporus* occurs here. The eastern part, the road to Mahiyangane is dominated by Myrtaceae, wind is here an important factor. In the West near summits there is a vegetation of *Syzygium fergusonii*. *Aglaia* formation occurs here, but is also present near Doublecutting in the Maskeliya area. There are two different species of *Aglaia*, formerly not recognized. The drier part of the Knuckles is Cardamon country. Contrarily what W. Meyer once stated, that cardamon will save the vegetation, it will absolutely exterminate it, as the forest floor has to be kept clean from saplings and seedlings. I have called the protecting tree layer a skeletal forest.

A patch of *Oncosperma ?horrida* forest was observed on a dry slope. Some rare giant trees of a *Calophyllum* species occur in a small patch.

As part of the Knuckles are still undisturbed, it is worth while to perform ecological research here. For dipterocarps the area is not interesting.

Concludions. The only way to know about associations and their distribution is to make grids of line transects with plots at places where the taxonimist/ecologist discovers differences in species. This is an enormous work, already much hampered by the destruction of the original vegetation.

There is a Dry Zone area with hundreds of associations, a very poorly defined Midmountain zone, which perhaps does not exist, but is simply an ecotone; a Montane Zone and a Mountain top zone.

These are the main vegetation types, defined by temperature and rainfall (duration of dry periods).

The subdivisions of these main types have to be based on associations/ series, made up of species. The associations form the mosaic of the vegetation.

DIPTEROCARPACEAE AND KEY TO THE GENERA

Mostly tall, rarely very small (*Stemonoporus*), usually evergreen trees, often buttressed with rather smooth to flaky to fissured bark, usually with an indumentum of unicellular stellate or simple hairs or of scales. Sometimes multicellular long stalked (*Vateria*) or capitate (*Dipterocarpus*) hairs. Branching first monopodial, later sympodial in emergent species. Leaves spirally arranged, simple with entire or sinuate, but not crenate margins with a more or less pronounced geniculate petiole, penninerved, rarely obscurely triplinerved, often with hairy domatia in the axils between midrib and lateral ribs, tertiary nerves reticulate or scalariform. Stipules large or small, persistent or fugaceous, leaving short to amplexicaul conspicuous scars. Inflorescences paniculate, usually racemose, terminal or axillary, sometimes reduced to a single flower. Bracts and bracteoles paired, tiny or large, persistent or fugaceous. In *Stemonoporus moonii* numerous stipules on the apical branches. Flowers second or distichous, bisexual, actinomorphic, scented, nodding. Calyx persistent, 5-merous, 2–5 sepals usually greatly enlarged in fruit, erect, wing-like; sepals either free to base, imbricate in bud, remaining so or becoming valvate in fruit, or fused at base, forming a cup, enclosing more or less the nut, free or adnate to it. Corolla 5-merous, contorted, bases of petals connate, the corolla falling as a rosette, or free. Stamens (in Ceylon species) 10 to many, 1–3-verticillate, hypogynous or subperigynous, centrifugal; anthers erect with (2–) 4 pollensacks, opening by longitudinal slits (in *Stemonoporus* pseudomonoporus), usually laterally dehiscent, connective protruded into a long and slender or short and thick appendage or appendages; filaments always narrowly triangular, flattened, free or connate at base, often cohering with the petals when falling. Pollen grains 2-celled at anthesis. Ovary superior or semi-inferior, 3 –, rarely 2–locular; style sometimes thickened at its base into a stylopodium; stigma obscure or prominent, lobed. Ovules 2 (–3) in each loculament, axillary, pendulous, usually anatropous, bitigmate with ventral raphe and superior micropyle. Fruit dehiscent or not, one-seeded with woody or thin pericarp

with aliform erect enlarged sepals, or sepals thinner, pressed to the base of the fruit or patent, not much enlarged, or woody, hard, pointing downwards (Vatica), pericarp splitting irregularly (part of Stemonoporus) or by longitudinal valves. Polygonum type of embryo sac development; endosperm of the nuclear type. Ripe seeds usually without endosperm, oily; cotyledons usually unequal with one more or less including the other, laminar or fleshy, entire or lobed and folded enclosing the radicle. Germination epigeal or hypogeal. Wood with resin channels.

There are 18 genera with circa 580 species. In Malesia 10 genera with circa 390 species; in Sri Lanka 9 genera with 58 species (all endemic). Of the 9 genera, two are endemic (*Doona and Stemonoporus*).

Two basic chromosome numbers are known so far, 7 (*Shorea, Hopea*) and 11 (*Dipterocarpus, Vatica, Stemonoporus*). Polyploidy is not common.

Key to the genera

1. Stipules amplexicaul leaving amplexicaul leaf scars. Leaves plicately folded in bud, the plicate vernation persistent giving the leaves a corrugate appearance. Flowers large. Base of the calyx fused into a tube, at least half enclosing the nut, not fused with it. Petals falling as a rather loose rosette. Calyx lobes valvate growing out in the fruit into 2 long, distinctly 3-nerved wings, the other 3 calyx lobes remaining short. Nut not dehiscent,..... 1. *Dipterocarpus*

1. Stipules not amplexicaul, leaving small scars. Leaves not plicate in bud and leaves not showing plicate venation. Flowers small. Calyx lobes rather distinct, not fused into a tube. Calyx lobes developing in the fruit into 2 long ones and 3 short wings or 3 long ones and 2 short ones or calyx lobes free not enlarged in the fruit or short, patent, equal, or reflexed, pointing downward, thickened. Fruits (nuts) not dehiscent or dehiscent longitudinally by valves or the exocarp tearing irregularly.

2. Calyx lobes in fruit long, winglike, erect.

3. Base of wings thickened, saccate, appressed, erect.

4. Two long winglike calyx lobes, the other calyx lobes small ..... 5. *Hopea*

4. Three long winglike calyx lobes, the other two calyx lobes remaining small.

5. Indumentum of simple hairs. Large, thick, club-like erect connectival appendix. Dark red very broad connectival tissue between the acute anther cells. Chemically different ..... 7. *Doona*

5. Indumentum stellate-haired or lepidote. Connectival appendages long, very thin, aciculate. No red tissue. Chemically different..... 6. *Shorea*

3. Base of wings in fruit not thickened, not saccate, free from the nut ..... 2. *Sunaptea*

2. Calyx lobes in fruit not growing out into wings.

6. Calyx lobes in fruit only slightly enlarged, clasping the nut ..... 8. *Balanocarpus*

6. Calyx lobes in fruit equal, slightly enlarged, patent and thin or reflexed, thickened, pointing downward.

7. Stamens without connectival appendix, anthers opening by a pseudo-pore. Fruit dehiscent by valves or the epicarp tearing irregularly..... 9. *Stemonoporus*

7. Stamens with apical connectival appendix, anthers dehiscent longitudinally by slits.

8. Stamens 15 with short, erect deltoid thick connectival appendages. Stigma trilobed, distinct ..... 3. *Vatica*

8. Stamens 45–50 with very short, awnlike, appendages, turned somewhat outwards. Stigma obscure ..... 4. *Vateria*

SPECIES

1. *Dipterocarpus* Gaertn. f.

De Fructibus 3: 50, t. 187, 188. 1805; Blume, Bijdragen Fl. Nederl. Ind.: 223. 1825; A.DC., Prodr. 16(2): 610. 1868; Dyer, in Hooker f., Fl. Brit. Ind. 1: 294. 1874; J. Bot. 12: 101, 152, t. 143–145. 1874; Vesque, Comptes rend. Acad. Sci. Paris 78: 625. 1874; J. de Bot. 12: 149. 1874; Burck, Annales Jard. Bot. Buitenzorg 6: 194. 1887; Heim, Recherches Diptér.: 24. 1892; Brandis, J. Linn. Soc. 31: 24. 1895; Gilg in Engler & Prantl, Nat. Pfl.fam., ed. 2. 21: 250. 1925; van Slooten, Bull. Jard. Bot. Buitenzorg, Ser. III, 8: 263. 1927; Symington, Malay. For. Rec. 16: 153. 1943; Smitinand, Thai For. Bull. 4: 1. 1958; Ashton, Manual Dipt. Brunei 16. 1964; Gard. Bull. Singapore 31: 5. 1978; Smitinand, Thai For. Bull. Bot. 12: 24. 1980; Ashton, in Fosberg & Dassanayake (eds.), Revised Handb. Fl. Ceylon 1(2): 169. 1977; reprint 1: 368. 1980; in Fl. Malesiana, Ser. I, 9(2): 291. 1982. — Type species: *D. costatus* Gaertn. f.

Oleoxylon Roxburgh, Trans. Soc. Arts London 23: 413. 1805, nomen; Ashton in Fl. Males., l.c. 292.

Pterigium Correa, Ann. Mus. Paris 8: 397. 1806, p.p.; Endlicher, Gen. Pl. 1013. 1840 (*Pterygium*); Ashton, l.c.

Mocanera Blanco, Fl. Filip.: 446. 1837, p.p.; Ashton, l.c.

Duvaliella Heim, Bull. mens. Soc. Linn. Paris 2: 1011. 1892; Ashton, l.c.

Heimiatoma Pierre, Fl. for Cochinch. 4: t. 259. 1892.

Tall trees (Ceylon) with rounded, usually small buttresses, rarely tall straight ones. Crown rather open. Bark usually rather smooth, becoming flaky. Twigs usually with conspicuous amplexicaul stipules scars. Stipules very large, caducous, carpeting the forest floor when shed. Leaves as a rule coriaceous, nerves prominent beneath, straight, curved only near the margin with traces of the plicate venation persistent between them, giving the lamina a corrugated appearance; tertiary nerves scalariform. Petiole stout, conspicuously geniculate.

Inflorescences racemose, short, stout, zig-zag, few-flowered, sparingly branched; bracts as stipules, but smaller, fugaceous. Flowers large. Calyx united around the fruit into a tube, but not fused (only at the base); lobes

valvate, 2 long and distinctly 3-nerved, 3 short or all 5 short (not in Sri Lanka). Petals large, strongly contorted, losely cohering at base on falling, cream with a pink stripe down the centre. Stamens 15–40, persistent initially in a ring around the ovary after the petals fall; filaments broad, flat, tapered apically, connate at the base. Anthers with 4 pollen sacs, latrorse. Appendages of the connective short or long. Ovary enclosed in the calyx tube with a cylindrical stylopodium, style filiform.

Fruits large. Calyx tube becoming constricted into a distal neck as the nut expands; nut ovoid with style remnant. Calyx lobes developing into 2 long wings the other 3 remaining short. Germination hypogeal, the intricately folded cotyledons remaining within the fruit and the plumule freeing itself by elongation of the cotyledonary petioles. Seeds sometimes albuminous at germination.

Sapwood containing a resinous oil.

DISTRIBUTION: About 69 species in Asia, 4 endemic species in Sri Lanka. The fossil record in E. Africa is doubtfull.

ECOLOGY: The Sri Lanka species occur in the Wet and Intermediate zone, there are no species in the Dry zone. Ashton's view that seedlings need a high light intensity for survival is not true (*D. hasseltii* grows in Java very well initially in very dark and dense undergrowth).

ANATOMY: A very clearly defined genus. Twigs with many resin canals in 1–2 concentric rings, in the outer margins of the pits; leaf traces 3, arising in the distal half of each internode with 12 stipule traces; distal end of petiole with 1–3 semicircles of vascular bundles each with a resin canal, closed by an adaxial bar of collateral vascular tissue. See Maury-Lechon (1980).

USE: Medium heavy timbers, absorbing preservatives readily. The oleoresin is tapped for varnish and tallow. Tapping is carried out by cutting into the bole and wounding the tissue by burning. It is mixed with brick dust for brass workers to hammer unto.

TAXONOMY: A stable genus. Dyer (1874) divided it in several sections, based on fruit characters. These characters are often not stable even at the specific level: *D. zeylanicus* fruit are sometimes smooth, sometimes ribbed and are not correlated with other characters. However, they are useful for quick identification.

Key to the species

1. Shortly deciduous tree. Leaves large, cordate, densely persistently golden hispid beneath. Fruit calyx tube smooth, no wings or ribs.....2. *D. hispidus*

1. Evergreen trees. Leaf scabrous pubescent to glabrous beneath, base not cordate. Fruit calyx tube ribbed or winged (not always so in *D. zeylanicus*).

   2. At least 14 pairs of ribs. Fruit calyx tube ribbed or occasionally smooth 4. *D. zeylanicus*

   2. Not more than 13 pairs of ribs. Fruit calyx tube winged.

      3. Leaves glabrous, except the petiole. Calyx tube fusiform, wings exceeding 5 mm wide and adnate to the pedicel ..... 3. *D. insignis*

      3. Leaf scabrid beneath. Calyx tube becoming globose, wings at most 2 mm wide and not or hardly adnate to the pedicel.....1. *D. glandulosus*

1. *Dipterocarpus glandulosus* Thwaites. — Fig. 1, 1a

Enum. Pl. Zeyl.: 34. 1858; A.DC., Prodr. 16(2): 612. 1868; Dyer in Hooker f., Fl. Brit. Ind. 1: 297. 1872; Trimen, System. Catal. flow. Pl. and Ferns Ceylon 8. 1885; Handb. Fl. Ceylon 1: 115. 1893; Lewis, Trees and flow. Pl. W. and Sabaragamuwa Prov. 28. 1902; Alston, in Trimen, Handb. Fl. Ceylon 6 (Suppl.): 23. 1931; Worthington, Ceylon trees 47. 1959; Asthon in Fosberg & Dassanayake (eds.), Revised Handb. Fl. Ceylon 1(2): 169. 1977; repr. 1: 370. 1980; Nair & al., J. Econ. & Taxon. Bot. 3(3): 649. 1984. — Typus: *C.P. 2590* (PDA). *Dipterocarpus scabridus* Thwaites, Enum., l.c. 34; Dyer, l.c. 298; Trimen, Catal., l.c. 9; Handb. l.c. 115; Lewis, l.c.; Ashton, l.c. 22. — Lecto typus (Ashton): *C.P. 2692* (PDA); syntypus: *C.P. 3406, p.p.* (PDA).

Trees, up to 45 m tall and 1 m dbh. with few, rounded concave buttresses. Bark pale orange-brown, verrucous lenticellate, thinly, irregularly flaky. Buds, stipules, twigs, leaf nerves, midrib on both surfaces, petiole, raceme, calyx, parts of petals exposed in bud and nut persistently golden brown scabrid pubescent, intercostals below and fruit calyx sparsely so. Twigs slender. Leaf buds up to 10 × 3 mm, falcate-lanceolate, acute. Stipules up to 3.5 × 1 cm, lanceolate. Leaves narrowly elliptic to lanceolate, 6.5–13 × 3–6.5 cm, coriaceous, rather flat, acuminate (acumen slender, tapering, up to 1 cm long), base cuneate; above midrib and ribs flush with the surface, underneath midrib slender, prominulous, ribs 10–13 pairs, slender, prominent, straight, ascending; intercostals slender, densely subscalariform. Petiole slender, 1.5–2.5 cm long, prominently geniculate.

Racemes up to 5 cm long, slender, few-flowered, little branched. Flower bud fusiform, up to 15 × 5 mm. Stamens 15; appendage to connective as long as anther. Style and stylopodium columnar, lower half pubescent.

Fruit pedicel slender, 3–8 mm long, the 2 longer wings oblanceolate, obtuse, up to 10 × 2 cm, tapering to ca. 6 mm wide above the tube; the 3 shorter lobes ovate, up to 11 × 5 mm. Tube subglobose, up to 18 mm diam., with 5, up to 2 mm wide, narrow ribs. Sapling leaves up to 35 × 10 cm with narrowly obtuse base, up to 4 cm long, slender acumen and more less prominently dentate margin and up to 22 pairs of ribs.

DISTRIBUTION: Endemic, wide-spread in S.W. Sri Lanka; Ambagamuwa, Kitulgalle, Siyane Korale, Kuruwita Korale, Karawita, Ratnapura, Kanneliya, Bambarabotuwa, Balangoda, Rakwana, Kottawa.

ECOLOGY: Below 1000 m altitude on well-drained soils. Exterminated by tappers in many forests. Flowering March and April, at long intervals.

USE: Tapped for its oily resin (Dorana tel).

VERNACULAR NAMES: Dorana (Sinh.)

NOTE: The type specimen of *D. scabridus* consists of leafy twigs of sapling and young trees, with a few detached fruit, mixed with some of *D. zeylanicus*.

Ratnapura Distr., Ambagamuwa and Ratnapura, *sine collector, C.P. 2590* (B, K, PDA); Kandagama, Ratnapura, sine coll., *C.P. 2692* (K, PDA); Gilimale, *Worthington 3185* (BM); Eknaligoda Kande, Karawita, *Ashton 2008* (PDA, US); Galle Distr., W. of Gin Ganga, Hiniduma, *Worthington*

2297 (BM); Naunkita Ella, Kanneliya For. Res., *Worthington 3701, 4150* (BM); Galle, *sine coll. 2115* (PDA); Hiniduma Kande, *Meyer 566* (PDA); Kanneliya, *Meyer 539* (PDA, US); *Cramer 3070* (PDA, US); *sine coll. 292* (PDA); Kottawa Arboretum, *Ashton 2036, 2037* (PDA); Natara Distr., Dediyagala For. Res., *Pannudurai 203* (PDA); Kandy Distr., Base of Adam's Peak, *Meyer 503* (PDA, US).

2. *Dipterocarpus hispidus* Thwaites. — Fig. 2, 2a

Enumer. Pl. Zeyl. 33. 1858; A.DC., Prodr. 16(2): 608. 1868; Dyer in Hooker f., Fl. Brit. Ind. 1: 296. 1872; Trimen, System. Catal. flow. Pl. & Ferns Ceylon: 8. 1885; Handb. Fl. Ceylon 1: 114. 1893; Lewis, Trees & flow. Pl. W. and Sabaragamuwa Prov. 27. 1902; Alston, in Trimen, Handb. Fl. Ceylon 6 (Suppl.): 22. 1931; Worthington, Ceylon Trees 48. 1959; Asthon in Fosberg & Dassanayake (eds.), Revised Handb. Fl. Ceylon 1(2): 170. 1977; reprint 1: 371. 1980; Nair & al., J. Econ. & Taxon. Bot. 3(3): 649. 1984. — Lecto typus (Ashton): *C.P. 2903* (PDA); syntypus: *C.P. 3405, p.p.* (PDA).

Dipterocarpus oblongifolius Auct. (non Blume) Thwaites, l.c. 33; Dyer, l.c. 296 (as a synon. of *D. hispidus*); Trimen, Syst. catal., l.c. 8; Ashton, l.c. 271. — Typus: *C.P. 3405* (PDA).

Dipterocarpus oblongus A.DC., Prodr. 16(2): 608. 1868; Dyer, l.c. 296 (as a synon. of *D. hispidus*); Ashton, l.c.

Trees, up to 45 m tall and 130 cm dbh. with low rounded buttresses, shortly deciduous. Bark orange-brown, flaky. All parts, except stipules inside initially densely long golden-brown hispid, fugaceous on upper surface of leaves, caducous on fruit calyx and becoming scabrid on the lower leaf surface. Twigs rather stout, dark brown. Leaf buds ovoid, subacute, up to 20 × 12 mm. Stipules oblong-elliptic, obtuse, up to 20 × 8 cm, large. Leaves large, oblong-ovate, sub-chartaceous and floppy, (11.5–) 18–50 × (6.5–) 9–26 cm, acumen long tapering up to 12 mm, base cordate, ribs 14–24 pairs, ascending, straight, above midrib and ribs shallowly depressed; below prominent, frequently intercostals. Petiole 2–7 cm long, 3–5 mm diam.

Flower bud ellipsoid-oblong, up to 3.5 × 2 cm. Stamens 15, connectival appendage shorter than the long, slender anthers. Style and stylopodium enlarged in the basal half, rather long-pubescent, except in the distal third. Raceme up to 10 cm long, hardly or not branched, bearing up to 5 distichous shortly pedicellate fruit. Fruit calyx tube up to 3 cm diam., subglobose, smooth, tapering into the up to 8 mm long tapered pedicel. The 2 longer wings spathulate, obtuse, up to 17 × 4 cm; the 3 shorter lobes broadly elliptic, obtuse, up to 15 × 19 mm. Sapling leaves very large, narrowly elliptic-oblong to obovate.

DISTRIBUTION: Endemic. Wide-spread in the Wet zone: Kitulgale, Kuruwita, Gilimale, Ratnapura, Kiribatgale, Udakarawita, Rakwana, Kottawa, Kanneliya, Kukul Korale, Sinharaja forest, Pasdun Korale, Gin Ganga valley beyond Deniyaya.

ECOLOGY: Locally common, below 1000 m altitude, very common in moist places. Flowering in April, at long intervals.

VERNACULAR NAMES: Bu Hara (Sinh.)

NOTE: The type of *D. oblongifolius* Thw. consists of fallen fruit of *D.*

hispidus, with leafy twigs with very young fruit which are not typical for this species in the retatively small size of the leaves (in parenthesis in the description), hardly raised intercostals and obtuse base. This, plus the evident ribs on the calyx tube, suggest that the specimen have been collected from a hybrid with possibly *D. glandulosus*, Ashton consequently chose the fruit only as the lectotype.

Ratnapura Distr., Kursipilai Kande, *sine collector C.P. 2903* (K, PDA); Ratnapura, *sine collector C.P. 3405* (K, PDA); Kitulgale, *Worthington 413, 414 A* (BM); *Ashton 2005* (PDA, US); Rakwana, Orange Field Estate, *Worthington 2141* (BM); Gilimale Forest Res., *Meyer 421* (PDA, US); Galle Distr., Nellowe-Pellawatte road, *Ashton 2078* (PDA); Kanneliya, ster., *Kostermans & Jayasuriya 2370* (PDA); Kottawa, *Wijesinghe 80* (PDA), *sine coll. 291* (PDA).

3. *Dipterocarpus insignis* Thwaites. — Fig. 3

Enumer. Pl. Zeyl. 34. 1858; A.DC., Prodr. 16(2): 612. 1868; Dyer in Hooker f., Fl. Brit. Ind. 1: 298. 1872; Trimen, Handb. Fl. Ceylon 1: 116. 1895; Asthon in Fosberg & Dassanayake (eds.), Revised Handb. Fl. Ceylon 1(2): 170. 1977; reprint 1: 272. 1980. — Typus: *C.P. 3408* (PDA).

Evergreen tree, up to 45 m tall and 1.5 m dbh. with up to 2 × 2 m, almost straight rounded buttresses. Bark pale chocolate-brown, becoming thickly flaky, pale lenticellate. Leaf and outside of stipules densely persistently rufous hispid, young twigs, petioles and sometimes buds caducously so, leaf nerves and midrib below and base of raceme sparsely caducously so; petals outside densely buff pubescent, otherwise glabrous. Twigs thin, ca. 4 mm diam., apically stout, pale brown, verruculous, much branched. Leaf bud stoutly ellipoid, obtuse, up to 6 × 5 mm. Leaves ovate to elliptic, ca. 7–12 × 4–6 cm, coriaceous with long up to 8 mm long, tapering acumen, base narrowly to broadly obtuse; margins sinuate in the distal half; ribs 10–12 pairs, straight, ascending especially distally, above shallowly depressed between the subpersistent plicate folds of the leaf, midrib similar, intercostals very slender, densely scalariform; below midrib and ribs prominent. Petiole 1.5 – 2.3 cm long, ca. 2 mm diam.

Racemes up to 8 cm long, axillary, lax, hardly branched. Flower buds up to 3.5 × 1 cm, ellipsoid. Calyx glabrous, winged. Stamens ca. 37, very slender and long; connectivital appendage shorter than the anthers. Style and stylopodium long and slender, columnar, shortly puberulent, except the apex.

Fruit pedicel up to 7 mm long and 2 mm diam. The two long wings lorate, up to 9.5 × 2 cm, hardly tapering at base and to the obtuse apex; the 3 short lobes up to 5 × 6 mm, sinuate. Calyx tube fusiform, up to 3 × 2 cm, including the wings; the wings up to 7 mm wide, continuing below the base and adnate with the pedicel. Seedling leaves oblanceolate, up to 18 × 5 cm, with cuneate base and up to 3 cm long caudate acumen; petiole ca. 1 cm long. Young tree leaves up to 24 × 11 cm, narrowly elliptic, with up to 17 pairs of ribs.

DISTRIBUTION: Endemic. Scattered and widespread but never common in the Wet zone: Gilimale, Ratnapura, Hewesse, Pasdun Korale, Kanneliya For. Res., Hiniduma, Nellowe.

l.c. 268; Brandis, J. Linn. Soc. 31: 116. 1895; King, J. Roy. Asiat. Soc. Beng. 61(2): 102. 1893; Symington, Mal. For. Rec. 16. 1943, repr. 211. 1976; Ashton, l.c. 345. — *Vatica*, subgen. *Sunaptea* Brandis, l.c. 128; Gilg in Engl. & Prantl, Nat. Pfl.fam., ed. 2, 21: 266. 1925 (*Synaptea*); van Slooten, Bull. Bot. Gard. Buitenz., Sér. 3, 9: 67. 1927; Ashton, l.c. 345 and 359.

Vatica p.p., van Slooten in Bull. Bot. Gard. Buitenz., Ser. 2, 17: 245. 1942; Ashton, l.c. 345, p.p., quoad *Sunaptea*.

Pteranthera Blume, Mus. Bot. Lugd. Bat. 2: (1852) 30. 1856, p.p., quoad *Shorea mangachapoi* (Blanco) Blume.

Mocanera Blanco, Fl. Filip. 450. 1837.

Vatica, sect. *Euvatica* Benth. & Hook., Gen. Pl. 1: 192. 1862; Dyer in Hooker f., Fl. Brit. Ind. 1: 301. 1875; Burck, l.c. 224. 1887; King, l.c. 102. 1893; Ashton, l.c. 359.

Cotylelobium Pierre, Fl. for. Cochinch. 3: t. 235. 1890; Heim, Rech. Dipt. 119. 1892; Brandis, J. Linn. Soc. 31: 114. 1895; Gilg in Engl. & Pr., l.c., ed. 2, 21: 213. 1925; van Slooten, Bull. Jard. Bot. Buitenz., Sér. 3, 10: 393. 1929; ibid. 12: 43. 1932; Symington, Mal. For. Rec. 16: 232. 1943, f. 111; Ashton, Man. Dipt. Brun. 56. 1964; Suppl. 24. 1968; Blumea 20: 358. 1972; in Fosberg & Dassanayake (ed.), Revised Handb. Fl. Ceylon 1: 365. 1980; in Fl. Males., l.c. 340; Meyer & Wood, Sabah Forest Rec. 5: 325. 1964. — Type species: *C. melanoxylon* (Hooker f.) Pierre.

Dyerella Heim, Rech. Dipt. 123. 1892; Ashton, l.c. 340. Type species: *Sunaptea odorata* (Roxb.) Griff.

Medium sized to large trees. Buttresses low, rounded, similar to those in Vatica. Crown rather small. Bark greyish, initially smooth, hoop — marked, later irregularly thinly flaked. Live bark and wood as in Vatica. Stipules fugaceous. Leaves coriaceous, margin slightly revolute, underneath lepidote; nerves thin, bifurcating towards the margin and anastomising in an intramarginal nerve, numerous, parallel, with shorter similarly bifurcating intermediates; intercostals obscure, reticulate; midrib impressed on the upper surface. Petioles short, hardly geniculate.

Panicles many-flowered; flower ,buds lanceolate. Sepals more or less valvate, subequal; petals cream, pubescent on parts exposed in bud, falling separately. Stamens 15, subequal in three whorls; pairs alternating with single stamens; filaments short, deltoid, connate at base; anthers narrowly oblong, 4-celled, the inner pair shorter than the outer one; connective exserted only half the anther length, columnar. Ovary free from calyx, no stylopodium; style thin, much longer than the ovary, towards base shortly pubescent; stigm small, trifid. Fruit winged.

In Ceylon only one species.

Introduction

The presentation of a new or revised generic taxonomic system, simply implies that the author takes a different view on divisional boundaries between taxa higher than the rank of species. The basic building-stones of any taxonomic system are still the species, however badly defined or circumscribed. Combining these building stones into the next higher category, whether a section, a sub-genus or a genus, is more or less a matter of taste, of background, etc. and purely subjective. One can go to the extreme

at one end, like N. Saddi (Kew Bull. 39 (1984) 729–740 who created for practically every species of *Kielmeyera* a section or sub-section or at the other end, in a phylogenetical system, where Dahlgren created new super taxa (and for this was heavily critisized by Corner, cf. J. Linn. Soc.).

Symington in 1943 (Forester's Manual of Dipterocarpaceae, Mal. For. Rec. 16, p. 211) professed: "It is now generally agreed that generic sub-division (of Vatica) in injustifiable", a meaningless statement, which only mirrors Symington's subjective thinking, so ingrated that he lowered the sub-genera of Vatica of van Slooten to sectional rank (*Synaptea* (Griff.) Brandis, Isauxis (Arn.) Brandis, *Pachynocarpus* (Hooker f.) v. Sl. and *Keramides* v. Sl., the last one later proved to be *Mesua* in Guttiferae).

Real natural taxonomic systems are still the exception, not the rule, as our subjective weighting of characters is based on contempory evidence only; knowledge of additional fossil material might or is almost sure to change the picture completely. We do not know the origin of the Dipterocarpaceae and we cannot state with certainty to what other families they are related (Guttiferae, Theaceae, Tiliaceae, etc.) and consequently its position in supra-familial categories is pure guesswork.

The only character state, solely limited to the family, is the shape of the anther and filament, constant without a single exception.

In Dipterocarpaceae, like in other families, existing generic sub-divisions reflect the specialisation of their creator, whether he is a herbarium taxonimist, a forester, an anatomist (Burck), a morphologist, a phyto-chemist, etc. But this is not the only influencing factor; very interesting are factors of nationality; the French School (Maury) adhering to the French system of Heim (more or less); the British School (Ashton) sticking to Bentham & Hooker, Symington, etc.

The German School had no follow-up since Gilg in 1925 sub-divided Vatica in 3 sub-genera, but astonishingly considered *Pachynocarpus* a separate genus.

Vegetative parts of the plants are obviously more important for foresters than flowers and fruit, because of their availability and hence Ashton in some cases gives higher rank to leaf nervation than to fruit characters.

Ashton, transliterated Symington's pure forester's system into a traditional taxonomic system, with all the pitfalls inherent to this.

The same author, although convinced, that Hopea and Shorea should be fused (according to him they differ in fruit characters only), did not do so, in order not to provoke the irk of foresters, lumberman or timber traders. Such an argument is not acceptable for a "pure sang" taxonomist; moreover Ashton's argumentation is weak, as people quickly accomodate to new names, not only new plant names, but look at the numerous changes in street and geographical names in the Third World, which have become accepted within a relatively short period (although with grumbling).

It is often pretended that the sexual apparatus of plants is morphologically stable and not influenced by outside factors and should hence have higher priority in weighting, but this has never been proved: flowers have changed in geological times and certainly partly under pressure from outside factors (Orchidaceae) and the saying that fruit have been more influenced by outside factors, looks very improbable.

The assumption, that mutations in the process of development initially are random, followed by a period that they are influenced from outside, is a

palatable hypothesis. Whether these mutations have been small-scale ones (more acceptable for our human thinking) or saltations is beyond our realm of knowledge.

In Dipterocarpaceae the presence of fruit wings is associated immediately with wind dispersal in our anthropocentric way of reasoning. But, if one looks for examples, it are only the very light-winged fruit, that can be advantageously dispersed by wind (the argument that wind is not or hardly present in tropical rain forest is a fallacy, in the pluricentennial lifespan of the tree, only one good high wind in a hundred years is sufficient for a very effective dispersal). The very heavy fruit with large wings of some Dipterocarpus species drop down like stones, and because of the long wings, they are caught in the branches of the underbrush, where they hang and die.

Shorea palembanica is riverine species with fruit dispersal by flowing water, nevertheless the fruit are light and have large wings. The reduction of wings in certain species (is this really a reduction, or is it a non-development?) can hardly be explained as adaptive.

In the family of Dipterocarpaceae, with the reticulated connection of the species, or in other words where the mutable characters are spread randomly, any kind of generic circumscription is defendable, we do not know how and when these characters developed and in what sequence, neither are we in the position to define them as adaptive or not during the millions of years of development.

Nervation of leaves, although perhaps not influenced by outside factors, can only be handled with care, as convergence is common and it has developed in most species probably independently to other characters. It is also a fallacy to believe that proper "natural" grouping should be based on more than one character state, as nobody will ever be able to identify the minimum number, 1, 2, or 3. The same holds true for the circumscription of a species. And finally there is no proof, that groups differing in more than one character state are more natural than those differing in only one.

After the above, I can only apologize for the system presented here. It has no more merits than any other system, except in my own mind.

A danger in the system of weighting the importance of character states, is, that it may create very unnnatural groups, expressed in artificial disjunct areas. A good example are *Cotylelobium* and *Vatica*, according to me artificially separarated on a nervation character only, resulting in disjunct areas of *Cotylelobium* (the exized group) repeating the fruit wing development as found in *Vatica* proper. I accept this as a proof, that Cotylelobium and *Vatica*, section *Sunaptea* have been artificially separated.

Cotylelobium Pierre and *Sunaptea* Griff.

Sunaptea was included in *Vactica* by Bentham and Hooker (1862), but reinstated again by de Candolle (1868). Dyer (1875) referred it again to Vatica, certainly influenced by the authority of Bentham and Hooker. Burck (1887) left it in Vatica but split the section into two: *Eu-Vatica* and Sunaptea proper, the latter differentiated by the fruit calyx lobes at the base grown into a cup adnate to the nut. Pierre (1890) and Heim (1895) reinstated the genus.

Maury (Thesis I B, p. 372 bis) presented in 1978 a new system of the tribe of *Vatica*, recognizing two subtribes; Upunanae and Sunaptiinae.

In the latter two genere were recognized: *Cotylelobium* Pierre and the reinstated genus *Sunaptea* Griff. In the second sub-tribe of *Vaticinae* only the

genus *Vatica* is accepted with the sections Vaticae (apparently including *Isauxis* and *Retinodendron*) and the section *Pachynocarpus*. The third and fourth tribus are the *Stemonoporinae* (one genus *Stemonoporus*, with two sub-genera, not sections: Stemonoporus "ronds" and St. "ovoides") and *Vaterianae* with *Vateriopsis* Heim and *Vateria* L.

I have pointed out, that the sub-division of the genus *Stemonoporus* could be based on the mode of dehiscence of the fruit: by valves (after germination), like in *Vatica* or by irregular rupture of the exocarp (quite an aberrant character). According to Ashton (Fl. Males., l.c. 341) under *Cotylelobium* the range of fruit variation strikingly resembles that of *Vatica* (meant is *Vatica*, sect. Sunaptea). Ashton included the Ceylonese Vatica lewisiana in Cotylelobium, I referred it back to Vatica, and "the wood anatomy underlines this, but the androecium, gynaecium and leaf nervation are quite distinct from that genus".

Comparison of the description of the two genera, as presented by Ashton, which is difficult as the two description are inconsistently elucidated, the following:

Buttresses in *Cotylelobium* are said to be similar as those of *Vatica*, but that they are concave in *Vatica*, and rounded in *Cotylelobium* (not comparable). Crown is sympodial in *Vatica*, nothing is stated for *Cotylelobium*, Stipules are mentioned in *Cotylelobium*, not in *Vatica*.

In *Cotylelobium* there is a distinct marginal vein, absent in Vatica; and kind of Dryobalanops type of lateral nerves and this is character not at the generic level, as it was considered by Ashton in his treatment of *Hopea* (dryobalanoid type), although in *Hopea* there is no marginal vein. In *Stemonoporus* there is one species with a pronounced marginal vein, all other species have none.

The inflorescence of *Cotylelobium* is not mentioned by Ashton (it is racemose). The calyx lobes in *Cotylelobium* are said to be imbricate, but in fig. 37 they are depicted as valvate; the two outer lobes are said to be somewhat longer than the three acute inner ones; however, according to fig. 37, they are almost equal in lenght. In *Vatica* they should be about valvate but in the drawing, fig. 42, of *Vatica umbonata* they are imbricate and they are furthermore as much subequal as those in *Cotylelobium.*

The petals of both genera do not differ, according to the description, and the conclusion is that the perianth of both genera is similar.

There are indeed differences in the gynaecium, style long and slender in *Cotylelobium* with small trifid stigma broader than the style as opposed to the short stout style with prominent 3-lobed stigma in *Vatica*, but these differences are certainly not at the generic level. The number of the stamens (15, but a Bornean *Vatica* has 5 stamens, not mentioned by Ashton) is the same, there is difference in the antherial appendage: short, slender in *Cotylelobium*, stout and somewhat deltoid in *Vatica*, again not at the generic level.

Conclusion: Androecium and gynaecium are not "quite distinct" as pretended by Ashton.

In the key of Ashton the two genera are differentiated by anthers linear in *Cotylelobium* (although they are called narrowly oblong in the description), in *Vatica* broadly oblong to globose (globose not mentioned in the description).

Symington described the stigma of *Vatica* in a way different from that of

Ashton: style terminating in a cup, that contains an obscurely trilobed stigma: so it has been described by van Slooten.

As the tree bark is exactly the same, like the timber and the fruit, I have here fused *Cotylelobium* with *Sunaptea* Griff.

In *Vatica* (Ashton, Fl. Males., l.c. 346) the following discrepancies were noted. The calyx lobes should be about valvate, but in fig. 42 of *Vatica* umbonata they are imbricate and should be subequal, but this holds true only for the section *Vatica*, not for section *Sunaptea*.

Blume's genus *Pteranthera* (1852) represents a mixture. One species (*Shorea mangachapoi*) belongs to the section *Sunaptea*, whereas *Vatica chinensis* is perhaps an Indian plant with a fruiting calyx of equal lobes, chartaceous and patent. If the genus should be recognized it takes priority over *Sunaptea*. It is advisable to reject it as a nomen delendum. There is some speculation that Blume saw neither of the species. Because the similarities elucidated above, I have included *Cotylelobium* in *Sunaptea*, in this was also getting rid of the artificial disjunction.

The fruit of *Sunaptea* have sometimes been compared with those of *Anisoptera*, but there are important differences: most species have their fruit sepals free to the base and were they are fused at their base, they do not or hardly form a cup but the fused part has the same consistency as the wings (which have different reticulation from these of *Anisoptera*) with two execptions: *Sunaptea heteroptera* and *S. badiifolia*, which have a flat, hard circular plate at the base of the fruit in which the not very long wings are implanted. These two species might not belong to *Sunaptea* proper; they are certainly not wind dispersed, like all other *Sunaptea* species.

It is possible that *Upuna* Sym. is more close to *Sunaptea* (exactly the same fruit; an inflorescence which can be explained as a reduced cyme, but the scaly bark is entirely different) than to *Vatica* sensu strictu.

At this stage, before having studied all Sunaptea species in detail, I am not in the position to judge the status of the other subgenera or sections of *Vatica* (*Pachynocarpus, Isauxis, Retinodendron*). To these should be added two other distinct groups: one with the species *S. heteroptera* and *S. badiifolia;* the other with the species: *V. chinensis* (India) and *V. paludosa* (Sri lanka), the latter close to Isauxis.

Sunaptea scabriuscula (Thw.) Trimen — Fig. 5

Syst. Catal. Pl. Ceylon 9. 1885; Handb. Fl. Ceylon 1: 126. 1893 (as a synon. of *Cotylelobium scabriusculum*); Atlas t.XII Lewis, Trees and shrubs fl. Pl. W. and Sabaragamuwa Prov. 34. 1902; Veget. Prod. Ceylon 40. 1934; Ashton in Fosberg & Dassanayake (edit.), Revised Handb. Fl. Ceylon 1(2): 168. 1977, repr. 1: 368. 1980 (as a synon. of *Cotylelobium scabriusculum*); Kostermans, Proc. Third Round Table Confer., Samarinda 621. 1987. — *Cotylelobium scabriusculum* (Thw.) Brandis, J. Linn. Soc. 31: 114. 1895; Trimen, Handb. Fl. Ceylon 5: 383. 1900; Alston in id. 6 (Suppl.) 25. 1931; Worthington, Ceylon Trees 66. 1959; Ashton, l.c. 168 and 367. — *Vateria scabriuscula*, Thwaites, Enum. Pl. Zeyl. 404. 1864; Trimen, Handb., l.c. 383; Ashton ll. cc. — *Vatica scabriuscula* (Thw.) A.DC., Prodr. 16(2): 620. 1868; Dyer, l.c. 303; Trimen, l.c.; Ashton, ll.cc. — *Dyerella scabriuscula* (Thw.) Heim, Rech. Dipt. 123. 1892; Bull. Soc. Bot. France 39: 153. 1892; Ashton, ll.c..; Kostermans, l.c. — *Stemonoporus scabriusculus* (Thw.) Heim, Rech. Dipt. 89. 1892; Ashton, l.c. 367; Kostermans, l.c.

Tree, up to 35 m tall, up to 50 cm dbh., usually smaller, sometimes coppicing. Crown compact, initially, oblong to hemispherical. Twigs, buds, petioles, undersurface of leaves, panicles, bracts, fruit calyx and those parts of the perianth exposed in bud, more or less sparsely tawny pubescent, in young stages densely so. Leaf bud — 3 × 2 mm, ovoid, acute. Twigs slender, terete, smooth. Leaves narrowly oblong to lanceolate, 7.5—22 × 2.5—8 cm, acuminate (acumen slender, c. 1,5—2 cm), base broadly cuneate to obtuse, ribs obscure above, 17—23 pairs, parallel, thin, but distinctly raised underneath, like the intermediate and reticulate intercostals. Petiole c. 1.5 cm long.

Panicles terminal or axillary, bracts narrowly ovate, obtuse, up to 7 × 4 mm. Fruit pedicel up to 8 mm, slender; calyx lobes unequal, the 2 longer ones up to 5.5 × 1.5 cm, lorate, obtuse, tapering to c. 4 mm broad at base; the 3 shorter lobes lanceolate, up to 2.5 × 7 cm, acute, nut up to 1 cm diam., subglobose, verruculose, style remnant persistent, up to 6 mm long. Sapling leaves up to 35 × 8 cm with up to 2 cm long, stout petiole.

DISTRIBUTION: Endemic. S.W. of the wet zone from Kottawa For. Reserve northward to Opata and N.Westwards to Hewesse and Pelawatte in Pasdun Korale; including Hiniduma, Nellowe and Kanneliya For. Reserves.

ECOLOGY: Wet, tropical rain forest, below 300 m altitude. Flowering in April and May, at long intervals.

Galle District, Kunelli Mukulana, Hiniduma, Worthington 2238 (BM); Kottawa Arboretum, Worthington 6014 (BM); Ashton 2033, 2034 (PDA,US); sine coll. 294 (PDA); Kanneliya For. Reserve, Worthington 6032 (BM); Ashton 3085, 2087 (PDA,US); Kanneli Ella, Hiniduma, Ashton 2097 (PDA); Hiniduma, sine coll., C.P. 3452 (K,PDA); Udugama, sine coll. 2129 (PDA); Kalutara Distr., Lenegal Kande & Hewesse, Pasdun Korale, sine coll. C.P. 3708 (K, PDA).

Excluded species

1. *Cotylelobium lewisianum* (Trimen ex Hooker f.) Ashton, Blumea 20: 358. 1972—1973 = *Vatica lewisiana* (Trimen ex Hooker f.) Livera.
2. *Sunaptea disticha* Trimen, System. Catal. Ceylon Pl. (18) 9 = *Doona oblonga* Thw.

3. *Vatica* L.

Mantissa Plant. 2: 152. 1771; Bentham & Hooker f., Gen. Pl. 1: 162. 1862 (including sect. *Isauxis* (Arn.) B. & H.); A.DC., Prodr. 16(2): 617. 1868; Dyer in Hooker f., Fl. Brit. Ind. 1: 302. 1874 (sect. *Isauxis*); Burck, Ann. Jard. Bot. Buitenz. 6: 223. 1887 (excluding sect. Sunaptea (Griff.) Burck; including sect. *Pachynocarpus* (Hooker f.) Burck, l.c. 225); Heim, Recherches Dipter. 99. 1892; Trimen, Handb, Fl. Ceylon 1: 127. 1893; Brandis, J. Linn. Soc. Bot. 31: 199. 1895 (excluding subgenus *Sunaptea* (Griff.) Brandis, l.c. 128; including subgen. *Retinodendron* (Korth.) Brandis, l.c. 119 and subgen. *Isauxis* (Arn.) Brandis, l.c. 127); Brandis & Gilg in Engler & Prantl, Nat. Pfl. famil., ed. 1, 3(6): 268. 1895; van Slooten, Bull. Jard. Bot. Buitenz. 3(9): 67. 1927; Foxworthy, Phillip. J. Sci. 67: 319. 1938; Symington, Malay. Forest Rec. 16: 211. 1943 (map); Ashton, Gard. Bull. Singap. 20: 243. 1963; Manual

Dipter. Brunei: 61. 1964; Suppl. 25. 1968; in Fosberg & Dassanayake (ed.), Revised Handb. Fl. Ceylon 1(2): 195. 1977; reprint id. 1: 420. 1980; in Fl. Males., Ser. I, 9(2): 345. 1982 (excluding Sunaptea Griff.); Meyer & Wood, Sabah Forest Rec. 5: 301. 1964; Smitinand, Thai For. Bull. (Bot.) 12: 81. 1980; Kostermans, Reinwardtia 10(3): 69. 1982; Maury-Lechon, Dipterocarpacées, Du Fruit à la Plantule, Thesis, 1A: 61 (excluding *Sunaptea*), 92 (embryo), 121 (cotyledons), 144, 148, 200 (trichomes). — *Seidlia* Kosteletzky, Allgem. Med.-Pharmac. Fl. 5: 1945. 1836. — *Vateria* Arnott, Ann. nat. Hist. 1(3): 155. 1839, p.p., as to Sect. Isauxis Arn.; in Wight, Illustr. Ind. Bot. 1: 88. 1840; Reichenbach, Nomencl. 210. 1841; Benth. & Hooker, Gen. Pl. 1: 199. 1962. — *Retinodendron* Korthals, Verhandelingen Natuurlijke Geschiedenis Nederl. Overzeesche Bezittingen, Bot. 55. Batavia 1839. — *Isauxis* Arnott, Ann. Nat. Hist. 3: 155.; in Wight, Illustr. Ind. Bot. 1: 88. 1840; Reichenbach, Nomencl. 210. 1841; Benth. & Hooker f., Gen. Pl. 1: 199. 1862. — *Pteranthera* Blume, Mus. Bot. Lugd. batav. 2: 30. 1852, p.p. — *Pachynocarpus* Hooker f., Trans. Linn. Soc. 23: 159. 1860; Gilg in Engler & Pr., Nat. Pfl. fam., ed. 2, 21: 226. 1925. — *Elaeogene* Miquel, Fl. Ind. Batav., Suppl. Sumatra 460. 1862. — *Retinodendropsis* Heim, C.R. Assoc. Fr. Pau 470. 1892 (1893). — *Perisandra* Gagnepain, Bull. Soc. Bot. France 95: 27. 1948; Jacobs, Blumea 15: 138. 1967. — *Brachypodandra* Gagnepain, l.c. 30.

Type species: *Vatica chinensis* L.

Small to medium sized trees, rarely large trees. Bole frequently sinuate. Buttresses absent or small, rounded, thick. Crown irregular, sympodial. Trees not or rarely emergent. Bark pale grey, smooth, hoop-ringed; in old trees becoming patchily flaked, thin; live bark pale brown to pink-brown, homogeneous with narrow fingers of dark phloem fibres; cambium cream; sapwood pale yellow, hard and close-textured. Resin clear. Young parts more or less shortly, densely caducous pubescent. Leaves spiral, with reticulate intercostals and very small, inconspicuous fugaceous stipules. Panicles somewhat irregular. Flower buds fusiform. Sepals valvate, equal; petals narrowly oblong, cream, often with a purplish tinge, falling separately. Stamens (Ceylon species) 15, in 3 whorls, single stamens alternating with pairs, short, the inner whorl slightly longer than the outer one; filaments short, dilated at base, more or less tapering and filiform below the anthers; anthers broadly oblong, the inner cells smaller than the outer ones; appendages short, rarely as long as the anthers, more or less deltoid, stout. Ovary ovoid, shortly, densely pubescent; no stylopodium; style columnar, short, glabrous, slightly expanded below the prominent conical, 3-lobed stigma. Fruit calyx variable, with thick, corky pericarp, supported by the subequal short thinly coriaceous (Ceylon species) lanceolate, recurved or patent sepals. Fruit splitting along 3 loculicidal sutures at germination, hypogeal, the subequal lobed laciniate cotyledons becoming later released, but hardly photosynthesizing. Sapling leaves somewhat larger but otherwise similar to those of mature trees.

DISTRIBUTION: About 30 species, in Ceylon (4 species), southern and eastern India, Burma, Thailand, Indochina, S. tropical China, Hainan and 24 species in Malesia (the section Sunaptea, Griff. is here treated as separated genus).

ECOLOGY: Tropical, lowland, evergreen forests or riverine forests in drier regions; up to 1600 m altitude. Rarely gregarious. Usually understorey trees.

USE: Timber hard, rather durable, but trees often do not reach timber size. The clear resin sometimes collected in Malesia.

NOTE: I have separated the section *Sunaptea* as a proper genus: *Sunaptea* Griff. According to Ashton the two main forms of calyx development seem to have appeared in remote times. *Cotylelobium*, closely related has been fused with *Sunaptea.*

Key to the Species

1a. Leaves very densely, minutely stellate-lepidote underneath; midrib impressed above. Fruit sepals pointing downward ..... 1. *V. lewisiana*

b. Adult leaves glabrous underneath; only stellate hairs present. Midrib prominent above. Fruit sepals loosely clasping the fruit base or patent 2

2a. Lateral nerves 6–8 pairs ..... , 7. *V. affinis*

b. Lateral nerves more than 11 pairs 3

3a. Leaves ovate to ovate-oblong, base rounded to subcordate; lateral nerves conspicuous on the lower surface. Fruit large, depressed globose, with rather thin, much enlarged sepals adpressed to its base ..... 3. *V. paludosa*

b. Leaves lanceolate to lanceolate-oblong, base rounded or acute; lateral nerves very faint on the lower surface. Fruit ovoid-globose, small, with rigid not enlarged patent or reflexed sepals ..... 4. *V. obscura*

1. *Vatica lewisiana* (Trimen ex Hooker f.) Livera — Fig. 6

Ann. Roy. Bot. Gard. Peradeniya 9: 97, t. XI (1–4). 1924; Lewis, Veget. Prod. Ceylon 49. 1934; Alston *in* Trimen, Handb. Fl. Ceylon 6 (Suppl.) 25. 1931 (as a synonym of *Vateria ? lewisiana*); Ashton, Blumea 20: 358. 1972 and *in* Fosberg & Dassanayake (ed.), Revised Handb. Fl. Ceylon 1(2): 167. 1977, reprint 1: 366. 1980 (as a syn. of *Cotylelobium lewisianum*). — *Stemonoporus lewisianus* Trimen ex Hooker f., in Trimen, Handb. Fl. Ceylon 5: 383. 1900; Lewis, Trees & Fl. Pl. W. and Sabaragamuwa Prov. 37. 1902; Veget. Prod. Ceylon 49. 1934; E.J. Livera, l.c. 97 (as a syn. of *Vatica lewisiana*); Alston, l.c. (as a syn. of *Vateria ? lewisiana*); Ashton, ll. cc. (as a syn. of *Cotylelobium lewisianum*); Kostermans, Reinwardtia 10(1): 70. 1882. — *Vateria lewisiana* (Trimen ex Hooker f.) Alston, l.c. 25; Ashton, ll. cc. (as a syn. of *Cotylelobium lewisianum*); Kostermans, l.c. — *Cotylelobium lewisianum* (Trimen ex Hooker f.) Ashton, ll. cc.; Kostermans, l.c. — Typus: *Lewis s.n.*, Jan. 1893 (isotype: 2 sheets); syntypus: *Lewis s.n.*, fr. April 1893 (PDA).

Tree, up to 35 m tall and 130 cm dbh. Buttresses none. Bark pale grey, becoming irregulary flaky (Ashton). Twigs thin, densely buff stellate-lepidote (scales very small). Stipules minute, caducous. Leaves rigidly coriaceous, oblong or elliptic, rarely (young trees) subovate-oblong, 2 × 5–4 × 10 (average)–7 × 17 cm, shortly (5 mm) acuminate, arumen with broad

base; base obtuse; above glossy, glabrous, smooth, the thin midrib slightly impressed, the lateral nerves very obscure; below very densely buff lepidote-stellate haired (scales with minute body and flat thin arms, very minute), midrib prominent, lateral nerves thin, prominulous, rather patent, c. 10 pairs with intermediate, almost as long ones, combined in a thin, wavy marginal vein, in between microscopic reticulation. Petiole slender, densely lepidote-stellate haired, 1–1,5 cm long, finely channeled above.

Panicles axillary, erect, lax, many-flowered, densely minute buff stellate-lepidote (arms more erect), up to 8 cm long. Branchlets few, short. Pedicels nodding, 4–6 mm long, densely stellate-lepidote. Sepals ovate-triangular, acute, densely lepidote-stellate, 2–3 mm long. Petals fleshy, white, broadly elliptic, obtuse, 6–7 mm long, 5 mm wide, the parts outside not covered by the adjacent petal densely buff lepidote-stellate. Stamens 15, in two whorls of 10 and 5, inner slightly longer. Filaments 1 mm, base broad, triangular, apex filiform; anthers oblong, appendix half as long, slender. Ovary densely pilose. Style as long as stamens with depressed capitellate stigma with 3 excrescences.

Fruit (immature) sub-globose, densely pilose; the sepals hardened, turned downwards.

DISTRIBUTION: Near Pelmadulla, Kiribatgalle and Hunawalakande.

NOTE: The species is in its salient characters not different from the other three Ceylonese species of *Vatica*, except the fruit sepals, which are turned downward and the stellate-lepidote leaves. For other notes cf. *Stemonoporus*.

Kiribatgalle near Pelmadulla, 750 m, ster., Ashton 2016 (quoted 2116) and 2117 (PDA); Kiribatgalle near Kahawatte, sapling, *Livera s.n.*, (PDA, 3 sheets); Apr. 1893, fr., *Lewis s.n.* (PDA); Nov. 1891, *Lewis*, sapling (PDA).

2. *Vatica affinis* Thw. — Fig. 7, 7a

Enum. Pl. Zeyl. 404. 1864; DC., Prodr. 16(2): 619. 1868; Dyer *in* Hooker f., Fl. Br. Ind. 1: 303. 1874; Trimen, Handb. Fl. Ceyl. 1: 128. 1893; Ashton *in* Fosberg & Dassanayake (ed.), Revised Handb. Fl. Ceylon 1(2): 195. 1977, reprint 1: 421. 1980; Maury, Dipterocarpacées, Du fruit á la plantule (Thesis): 1A: 63; 2: fig. 116, 228, 241, 473, 474, 587, 633, 678 NC. 11978; Kostermans, Reinwardtia 10(1): 71. fig. 1. 1982. — Lecto typus propositum: *C.P. 3416* Pasdoon Korale, Apr. 1855, young fr. and fls. (PDA); syntypus: Culture (Kalutara), *C.P. 3146* (PDA).

Isauxis roxburghiana Auct. non Wight, Thwaites, Enum, l.c. 37. 1858 and 404. 1864. — *C.P. 3416* (PDA).

Canopy tree, up to 35 m tall and 70 cm dbh. Bark smooth, grey, hoop ringed, thin. Branchlets apically with microscopical fugaceous indumentum or glabrous. Leaves chartaceous to sub-coriaceous, glabrous (initially) with few hairs below), ovate-oblong to ovate-lanceolate, 2,5 × 7–3,5 × 10–7 × 18 cm, acute, base obtuse to shortly acute, both sides minutely reticulate, above the slender midrib and thin lateral nerves prominulous, below midrib prominent, the 4–6 pairs of lateral nerves erect-patent (lower pair more erect), slender, prominent, arcuate; secondary nerves (intercostals) not different from the reticulation. Petiole slender, 1,5–3 cm long, apically thickened or not.

Panicles axillary, erect, many-flowered, up to 10 cm long with few thin main branchlets, up to 3 cm long with sparse microscopic indumentum of stellate hairs, indumentum becoming denser towards the flowers. Pedicels 2–3 mm long. Flower densely pale, stellate-pilose; sepals ovate, very acute, up to 3,5 mm long; petals pinkish yellow, narrow, up to 13 mm long. Stamens 15; ovary densely pilose, style with depressed capitulate stigma with obscure accrescences.

Fruit globose, smooth, glabrous, ultimately, 2–2,5 cm diam., the persistent sepals ovate to ovate-oblong, c. 1 cm long, 6 mm wide, loosely clasping the fruit, thickish; pedicel 6 mm long, fruit completely dehiscent, cotyledons free, epigeal. The first leaves in a whorl.

DISTRIBUTION: S.W. Ceylon. Wet, evergreen rainforest: Hiniduma, Kalutara, Hewesse, scattered, indifferent to deep or shallows soils. Not restricted to stream sides.

The leaves are not coriaceous (Ashton) and never elliptic (Ashton), the base is never broadly cuneate (Ashton), the inflorescences is a panicle, not a cyme (Ashton).

The fruit has no grooves at maturity, the fruit sepals are ovate or ovate oblong, not oblong (Ashton), the pedicel not 11 mm long, but shorter.

According to Maury the cotyledons remain within the half opened fruit after germination. In our material the valves drop completely.

According to Trimen the wood is like that of *V. paludosa*, but heavier and of darker colour.

Kalutara Distr.: Boralugodde, s. coll., young fr., C.P. 3416 (B, K, PDA 2 sheets); Nelunkeliya forest Res., Bajalingam 409 (PDA, n.v.); Galle Distr., Nellowe-Pelawatte road, April buds, Ashton 2074 (PDA); S.E. margin of Sinharaja forest, ster., Ashton 2083 (quoted as 2082) (PDA); Kanneliya forest, alt. 200 m, Febr., buds, Jayasuriya 1540 (PDA); ibid., April, fl., Waas & Peeris 560 (PDA); ibid, ripe fruit, Balasubramaniam s.n. (L).

3. *Vatica paludosa* Kosterm. — Fig. 8, 8a

Reinwardtia 10(1): 73, fig. 2. 1982 — Typus: C.P. 604 (PDA).

Vatica roxburghiana Auct. (non Bl., nec Benth.) Thwaites, Enum. Pl. Zeyl. 404. 1864; Dyer *in* Hooker f., Fl. Brit. Ind. 1: 302, 1874, p.p., quoad Ceylon; Trimen, Handb. Fl. Ceylon 1: 128, 1893 (exclud. cit. *Vatica chinensis*); Alston in ibid. 6 (Suppl.): 25. 1931; Worthington, Ceylon Trees 67. 1959; Ashton *in* Fosberg & Dassanayake (ed.), Revised Handb. Fl. Ceylon 1: 422. 1980 (id. 1(2): 166. 1977, exclud. cit. *Isauxis roxburghiana* Thw.). — *Isauxis roxburghiana* (Wight) Thwaites, Enum. 37. 1859, (non *Vateria roxburghiana* Wight), — *C.P. 3416* (later *C.P. 604*) (PDA).

Vatica chinensis Auct. (non L.), Alston, l.c.; de Rosayro, Ceylon Forester, N.S. 4(3): 293. 1960; Ashton, ll. cc.

Tree, up to 15 m tall and 50 cm dbh. Buttresses up to 1 m tall and 50 cm out, concave. Bark smooth, grey, resin plenty, clear, thin. Branchlets densely covered with brown, extremely small stellate scales with short arms, soon glabrous. Leaves chartaceous to sub-coriaceous, lower surface initially finely lepidote, soon glabrous, elliptic to ovate-elliptic, 5 × 12–10 × 25–15 × 30

(epicormic shoot) cm, gradually tapered to an obtuse tip or obscurely, broadly, obtusely acuminate (more conspicuous in juvenile plants), base rounded, very rarely sub-cordate; above smooth, glossy, midrib prominulous, lateral nerves thin, prominulous, secondary veins none or obscure; below paler, midrib slightly prominent, lateral nerves 7–11 pairs, erect-patent, slender, prominulous, towards margin arcuate, secondary nerves faint, scalariform. Petiole slender, 2.5–4.5 cm long, apical part thickened.

Panicles axillary of the terminal leaves, densely very minutely stellate pilose, rather few flowered, erect, up to 8 cm long with few, up to 3 cm long branches; pedicel thickish, up to 2 mm long. Calyx lobes thick, ovate, acute, 3–4 mm long, densely stellate pilose, the base forming a 1–2 mm high broadly funnel-shaped obscure tube. Petals rather thick, narrowly oblong 1 cm long, outside (where they are not covered by the adjacent one), densely, microscopically stellate pilose. Anthers with short apiculi. Stigma obtusely 3–lobed.

Fruit depressed globose, up to 5 cm diam. with 3 obscure furrows, densely microscopically lepidote, dehiscing by 3 thick, woody, ovate-acute valves; base with spreading, very thick, wrinkled, glossy, ovate, acutish 1–1,5 cm long lobes (at their base a little erect, then bending outwards). Cotyledons thick, each consists of two equal parts.

DISTRIBUTION: Endemic to Ceylon, growing in marshy land of the S.W. lowlands. Almost extinct.

VERNACULAR NAME: Mendora (Sinh.).

NOTE: *Vateria roxburghiana* Wight (Icones t. 26, Sept. 1838 and text sub Explan. of plates no II) is an Indian plant. In the text to plate 26, Wight made the remark: "I am indebted to the unaided ingenuity of the artist for these analysis who was not at the time of making them under my superintendence, and I have not since had the means of verifying them myself". In Illustr. Bot., Wight provided in 1850 a very short diagnosis of *Vateria roxburghiana*.

Thwaites in 1859 (Enum. Pl. Zeyl. 37) compared his specimens (*C.P. 604* from Kalutara, one sheet in young fruit, another in flower, PDA), with Wight's plate of *Vateria roxburghiana* and described it as *Isauxis roxburghiana* Wight (sphalm., it is a new combination of Thwaites), refering it in the Addenda of his book (404, 1864) to *Vatica* (quoting again *Isauxis roxburghiana* Wight, instead of Thwaites, as a synonym).

He made the remark: "I have little doubt of this being dr. Wight's plant, though there is a slight (sic!) discrepancy between my specimens and the figure in the Icones, but this is most likely due to a little want of accuracy on the part of the draughtsman".

Actually it was Thwaites who had the little want of accuracy; the plate is in all respects an almost ideal one of the Indian *Vatica roxburghiana*, which is quite different from Thwaites's Ceylonese plant.

The (for me) illogical way of reasoning of Thwaites, that an artist could be inaccurate in depicting a large fruit of *V. roxburghiana*, entirely different from that of the Ceylonese plant; he could be inaccurate in the small analysis of microscopical details.

C.P. 604, the Ceylonese plant has depressed globose, rather immature fruit with very thick, short sepals, whereas in *V. roxburghiana* the fruit are (young

and old) ovoid, very long pointed with very long, thin, transparent calyx lobes. There are also, less conspicous differences in the indumentum, the stamens and the stigma. I have been fortunate to collect the fully mature fruit of the Ceylonese plant.

De Candolle (Prodr. 1: 517. 1824) gave a short description of *Vatica chinensis* L. (Mantissa Pl. 242. Oct. 1771) and relegating it to Smith, Icon. Ined. t. 36 (and Lamarck, Dict. 8: 418, III. t. 397). In DC., Prodr. 16(2): 619. 1868 a more lengthy description was presented; here it was kept separate from *V. roxburghiana* (Wight) Bl. (p. 618).

Wight & Arnott (Prodr. 84. 1834) stated that *V. chinensis* was not from China and they thought, that it was probably identical with *V. laccifera* W. & Arn. (DC, l.c. 619, showed that this was not true).

Dyer (*in* Hooker f., Fl. Br. Ind. 1: 302. 1874) accepted Thwaites's viewpoint and included *V. chinensis* in *V. roxburghiana*. Trimen (Handb. Fl. Ceylon 1: 128. 1893) followed suit. He made the remark, that plate 26 of Wight might be this species, but the plate was not "characteristic".

Alston (*in* Trimen, Handb. 6, Suppl. 25. 1931), not going into the matter taxonomically, logically named the Ceylonese plant *Vatica chinensis* and was followed herein by Ashton (Revised Handb. Fl. Ceylon 1: 422. 1980).

Linnaeus must have seen a specimen of his *Vatica chinensis*, according to the description. Although the description is very poor, at least the "rami subtomentosi" militates againts this being the Ceylonese *V. paludosa* or the Indian *V. roxburghiana* and moreover, the latter two species have never ovate-cordate leaves.

It can be concluded that *Vatica chinensis* still might be a species from China.

The tree in the Botanical Garden of Peradeniya is *Vatica roxburghiana* with ovoid, long-pointed fruit. And the Heneratgoda Garden trees might be the same. Ashton collected some sterile specimens. There is still a possibility that the real *V. roxburghiana* occurs in Ceylon, although the chances are remote. Hence I have quoted below the sterile specimens with an interrogation mark. From the leaves alone the two species cannot be separated. Moreover, more developed flowers of *V. paludosa* are necessary to make sure whether the Heneratgoda specimens are this.

S.W. Ceylon, Kalutara Distr., Dec. 1854, fl., fr., *C.P. 604* (PDA); Kalutara Distr., Bulathsinhala near Horana, low marshy forest along a sluggish brown-water rivulet, inundated in the wet season, forest rich in *Syzygium cordatum, Stemonoporus moonii, Areca concinnea*, etc., 5 Sept. 1980, ripe fr., *Kostermans 28734* (AAU, G, L, PDA); W. Prov., Nurapatiya Hanwelle, near pond, alt. 30 m, ster., *Ashton 2060* (PDA) (?); banks of Kalu Ganga near Kiriella, 50 m alt., ster., *Ashton 2135* (PDA) (?); Heneratgoda Gatdeh, Apr., fl., *Simpson 9419* (PDA) (?).

4. *Vatica obscura* Trimen — Fig. 9

J. of Bot. 23: 203. 1885; ibid. 27: 161. 1889; Handb. Fl. Ceylon 1: 129. 1893 Atlas t.XIII; Lewis, Trees & fl. Pl. W. & Sabaragamuwa Prov. 35. 1902; Worthington, Ceylon Trees 68. 1959; Ashton *in* Fosberg & Dassanayake (ed.), Revised Handb. Fl. Ceylon 1(2): 196. 1977, reprint 1: 423. 1980; Kostermans, Reinwardtia 10(1): 77, fig. 3. 1982. — Typus: *Vincent* s.n., E. Province, anno 1882, fls. and fr. (PDA, 2 sheets).

Tree, up to 30 m tall and 70 cm dbh. Bark smooth, grey; no buttresses. Twigs either microscopically buff stellate pilose or glabrous. Stipules very slender, acute, 5–6 mm long, caducous. Leaves chartaceous, glabrous (young leaves initially sometimes with few hairs below), lanceolate to lanceolate-oblong, 1,5 × 8–3 × 16–14,5 × 15 cm, gradually acute or sub-acuminate, base rounded, sometimes shortly acute; both sides minutely densely reticulate (more conspicuous below); above glossy, midrib prominulous, lateral nerves faint; below more dull, midrib prominent, the c. 12 pairs of lateral nerves (with intermediate shorter ones) very thin and faint, erect-patent, arcuate near the margin. Petiole slender, 1–1,5 cm, concave above.

Panicles axillary and extra-axillary, many-flowered, up to 8 cm long, microscopically stellate-pubescent, denser towards the fragrant, white flowers with thin main peduncle and branches. Pedicels c. 3 mm, slender, densely stellate-pilose. Sepals ovate-oblong, acutish, 2–3 mm, densely stellate-pilose. Petals thin, up to 1 cm long and 4 mm wide, outside stellate-pilose, except the covered part at base by the adjacent petals. Filaments 0,5 mm with broad triangular base and filiform apical part. Anthers oblong, 1 mm with small appendage. Ovary densely pubescent. Style as long as the stamens; stigma depressed capitellate with 3 excresences at the top.

Mature fruit ovoid-globose, up to 3 cm long, smooth, glabrous with 3 faint longitudinal grooves. Sepals hardened, not enlarged, turned downwards. Pericarp leathery, 2 mm thick. Cotyledons red (turning green after germination), each splitting vertically almost completely into two, thick, wedge shaped halves. Germination epigeal, the fruit splits along the grooves into 3 valves, completely, the radicle comes out from the top and bends downwards, the epicotyl lifts the cotyledons (which looks as if there are 4) far above the ground and the valves drop. Wood hard, heavy, light brown.

DISTRIBUTION: Riverine forest from Polonaruwa and Batticaloa southwards; Devulane forest; also in Bintenne in Uva. Locally abundant.

NOTE: I doubt whether the tree reaches 30 m, I have seen them never more than 20 m high; the boles are as a rule straight. The fruit sepals are well described by Trimen, less acurately by Ashton.

Ashton misquotes Trimen; dummala is a Vedda not a Sinhala name (by Trimen given as dun). The Tamil name is tumpalai. Dummala in Sinhalase means simply resin. The tree produces a clear resin.

Badulla Distr., ster., Bailey s.n. (PDA); Kalodai, E. of Mahiyangane, bank of stream, dry zone, ster., *Ashton 2137* (PDA); Mahiyangane forest area, Monaragala Distr., June, fl., *Kostermans 24430* (PDA); Batticaloa, Polukanawa, June 1884, fl., *Walker 5, 132*, Sept. 1885, fr., *Walker s.n.* (on sheet 132 PDA); E. Province, Vincent, 1882, fl. (PDA, 2 sheets); Batticaloa, June, fl., *Livera s.n.* (PDA); Polonaruwa Distr., Yaklawa, E. of Wasganawa Reserve, ster., *Waas 604* (PDA); Maduroya, S. of Polonarruwa, Jan., ripe fr., *Kostermans 28022* (PDA); Devulana forest, Nuwaragala Res., riparian, low, May, fl., *Jayasuriya 2086* (PDA); 18th mile Ampara-Kandy Road, May, fl., *Kostermans 24850* (PDA); E. base Friar's Hood, Nuwaragala Res., May, buds, *Jayasuriya 2102* (PDA).

4. *Vateria* L.

Genera Pl., ed. 2: 153. 1737; ed. 2, aucta: 235. 1742; ed. 5: 231. 1754; De Jussieu, Genera Pl. 1789 (under Guttiferales); Gaertner f., De Fructibus 3: t. 189. 1805; Lamarck, Encycl. méth. Bot. 8: 417. 1808, p.p.; Blume, Museum Bot. Lugd. Bat. 2: 25, t. 4. 1852; Thwaites, Enum. Pl. Zeyl. 37. 1859, excluding sect. 2 *Stemonoporus* p. 403–404 and sect. 3 *Monoporandra* p. 404. 1864; Bentham & Hooker f., Genera Pl. 1: 193. 1862 (excluding *Stemonoporus*); A.DC., Prodr. 16(2): 624. 1868; Dyer in Hooker f., Fl. Brit. Ind. 1: 313. 1874 (excluding *Stemonoporus*); Burck, Ann. Jard. Bot. Buitenzorg 6: 181. 1887; Heim, Recherches Dipter. 85. 1892; Trimen, Handb. Fl. Ceylon 1: 132. 1893; Brandis, J. Linn. Soc. 31: 142. 1895; Brandis & Gilg in Engler & Prantl, Nat. Pfl.fam. 3(6 & 6a): 271. 1895 (excluding *Vateriopsis*); Ashton in Fosberg & Dassanayake, Revised Handb. Fl. Ceylon 1(2): 193. 1977; reprint 1: 418. 1980; Maury-Lechon, Dipterocarpacées, Du fruit la Plantule, Thesis 1 A: 65 (excluding *Vateria seychellarum*), 71, 74, 93 (embryo), 101, 123 (seedling), 202 (epidermis, stomata, trichomes).

Hemiphractum Turczaninov, Bull. Natural. Moscou 1: 262. 1895.

Vateria, sect. *Euvateria* Arnott, Ann. & Mag. Natur. Hist. 1(3): 155. 1893.

Type species: *Vateria indica* L.

Large trees without true buttresses; bole sometimes somewhat fluted towards the base, Crown momopodial. Bark smooth, pale grey, hoop-marked, later becoming irregularly flaky leaving scaloped surfaces. Wood soft. Young parts tomentose. Panicles axillary and subterminal, flowers pedicellate, secund, bracts conspicuous. Sepals slightly imbricate. Stamens many, 40–60, subequal; filaments very short; anthers long, linear, 2-celled; the abaxial sacs prolonged apically into recurved awns and short connectival appendages. Ovary crowned by a slender, columnar long style. Fruit large, ovoid, dehiscent from apex by 3 loculicidal sutures; persistent sepals slightly enlarged, hardened, pointing downwards. Pericarp thick, corky. Germination hypogeal, the large ruminate pinkish unequal cotyledons becoming released in germination but not photosynthesising.

DISTRIBUTION: Two species, one in Sri Lanka, one in southern India.

ECOLOGY: Wet tropical lowland forest.

NOTE: *Vateriopsis* of the Seychelles is very close and was included in *Vateria* by Maury-Lechon, but kept separate by Ashton.

Thwaites included in *Vateria* the sections *Stemonoporus* and *Monoporandra*. Ashton and Maury-Lechon recognized both *Vateria* and *Stemonoporus* and included *Monoporandra* in *Stemonoporus*.

10. *Vateria copallifera* (Retz.) Alston — Fig. 10, 11, 11a, 11b

in Trimen, Handb. Fl. Ceylon 6 (Suppl.) 26. 1931; Fischer, Kew Bull. 1932: 51; Worthington, Ceylon Trees 70. 1959; Meyer, Ceylon J. Sci. (Biol. Sci.) 10 (1): 76–79. 1972; Ashton in Fosberg & Dassanayake, Revised Handb. Fl. Ceylon 1(2): 194. 1977; reprint 1: 419. 1980; Maury-Lechon, Dipterocarpacées. Du fruit à la Plantule, Thesis. 1A: 65, 71, 93, 123, 202; 1 B: figs. 44

(fruit), 161 (cotyledons), 256 (stomata), 443 (epidermis), 539 (trichomes), 624 (f) (anatomy), 653–655 (cross sections petiole of the small cotyledons), 881, pages 308, 315, 322. 1978. — *Elaeocarpus copalliferus* Retzius, Observat. Bot. 4: 27. 1786; Vahl, Symbol. Bot. 3: 67. 1794; Willdenow, Spec. Pl. 2(2): 1170. 1798; Lamarck, Encyclop. mèth. Bot. 8: 418. 1808; Roxburgh, Fl. Ind., ed. Carey 2: 1603. 1834; Blume, Museum Bot. Lugd. Batav. 2: 29. 1852 (as a synon. of *Vateria indica* sensu Bl.). — Typus: Koenig s.n. (LD).

Vateria acuminata Hayne, Arzneigewächse (non Thwaites, Enum. Pl. Zeyl. 403. 1864, quoad *Stemonoporus acuminatus*) sub t. 15. 1830; A.DC., Prodr. 16(2): 625. 1868; Dyer in Hooker f., Fl. Brit. Ind. 1: 313. 1874; Trimen, Syst. Catal. 9. 1885; Handb. Fl. Ceylon 1: 131. 1893; Heim, Recherches Dipter. 87, f. 3. 1892; Brandis, J. Linn. Soc. 31: 143. 1895; Brandis & Gilg in Engler & Prantl, Nat. Pfl.fam. 3(6): 273. 1895; Lewis, Trees & flow. Pl. W. and Sabaragamuwa Prov. 36. 1902; Veget. Prod. Ceylon, l.c.; J.P.C. Chandrasene, Chemistry & Pharmacology Ceyl. & Ind. medic. Pl. 38. 1935; Ashton, ll.c..

Vateria indica Auct. (non L.) Moon, Catal. 42, 1824; (non L.) Blume, l.c. 29; (non L.) Thwaites, Enum. 37. 1858; (non L.) A.DC., l.c. 625; Ashton, ll.cc.

Hemisphractum oxyandrum Turczaninov, Bull. Soc. Natural. Moscou 1: 262. 1859.

Kaekuriaghaha odorata, ex qua fluit Gummi Elemi, Hermann, Museum Zeyl. 52. 1717; Burman, Thesaurus Zeyl. 28. 1731 (exclud. Plukenet), p.p.; Linn., Fl. Zeyl. 234. 1747; Blume, l.c. 29.

Myrobalanus zeylanica ex qua Gummi Elemi, Linn., Fl. Zeyl. 230. 1747, p.p.

Hal in Ferguson Descript. List Timbers in Ferguson's Directory 225–237 (Colombo 1863).

Grimm's, Laboratorico Zeylanico 108. 17.

Tree, up to 40 m tall and 130 cm dbh, usually, however, not more than 20 m, in youth with rather open to dense crown. Buttresses small, thick. Lower part of bole in old trees often somewhat fluted. Many, often large superficial roots. Bark smooth, grey, hoop-ringed, later irregularly flaking, leaving scaloped faces. Live bark up to 8 mm thick, pale yellow brown. Wood pale yellow, finely grained, rather soft. Twigs stout, densely, persistently dark fulvous tufted tomentose stellate hairy with scars of fallen leaves. Terminal bud large, surrounded by many narrowly hastate, up to 25 × 6 mm bud scales (stipules), outside furfuraceous. Leaves scattered, thickly coriaceous, oblong to oblong-ovate, 11–50 × 5–18 cm, base obtuse, to subcordate, with up to 8 × 3 mm abruptly tapered acute acumen; above rather smooth, rather dull, midrib narrowly impressed, ribs filiform, sub-impressed; below midrib stout, prominent, ribs erect-patent, prominent, somewhat arcuate towards the margin, 18– 25 pairs; intercostals distant, prominulous. Petiole stout, conspicuously tumid apically, 2–5.5 cm long.

Panicles aggregate near the twig apices, extra-axillary, up to 25 cm long with rather few, up to 12 cm long branches, bearing up to 10 or more secund flowers. Branchlets pale ochre. Bracts ovate, acute, concave, up to 5 × 10 mm. Flower buds lanceolate, rather large, up to 12 × 8 mm. Pedicels short. Sepals hastate, subequal, imbricate at the base only, sub-acute, ferrugineous outside, grey pubescent inside. Petals cream, oblong, ovate or sub-orbicular,

up to 12 mm long, bi-auriculate at base. Stamens 45–55; anthers introrse, yellow, long, linear, 2-celled; the abaxial cells prolonged apically in slightly spreading, awn-like connectival appendages, very short; filaments broad, connate at the base. Ovary ovoid, tomentose; style slender, columnar, glabrous, much longer than the ovary.

Fruit large, ovoid-ellipsoid, smooth to roughish, chocolate brown, obtuse, up to 7 × 12 cm; the persistent sepals much hardened, lanceolate, sub-acute, pointing downwards, sub-equal, up to 1 × 2 cm. Pericarp up to 3 cm thick, spongy, fibrous, base deeply impressed. Cotyledons markedly unequal, the larger one bi-lobed. Seedling hypogeal, the cotyledons escape by the lengthening of the cotyledonary petioles. Seedling leaves with 16 pairs of ribs, initially smaller than the leaves of mature trees with 2 cm long, rather slender petioles; stipules up to 15 mm long, acicular.

DISTRIBUTION: Widespread in the wet zone, from Colombo to Matare and Kandy.

ECOLOGY: Common in lowland Dipterocarp forest on hills and along rivers, below 1000 m altitude. Often cultivated. Flowering late April, regularly.

USE: The wood has no value, too soft. The bark is used for arresting fermentation of toddy. The fruit is ground into a flour; the resin is tapped for a clear varnish. Also used for burning as an incense in ceremonies and against dysentery, used as a fumigator for sick rooms.

VERNACULAR NAMES: Hal (Sinhal.); Kungiliyam Pinai (Tamil).

NOTE: Linnaeus' *Vateria indica* was based on Poenoe Rheede van Draakestein, Hortus indicus malabaricus, not on a Ceylonese plant. In the Hermann Herbarium (British Museum, vol 4) there is a poor specimen consisting of a flower and a leaf, which is not dipterocarpaceous and so far indeterminable. Linnaeus (Fl. Zeylanica 92, no. 204, 1747) under *Vateria* noted: Planta sicca in tomus quarta (of Hermann's herbarium) sed mutilato, descriptu tradi nequat (cannot be identified).

Dyer (repeated by Meyer, without mentioning Dyer), l.c. 313 stressed already that *Vateria* indica Linn. applied to Rheede's plant, which is undoubtedly the holotype. Dyer saw Hermann's specimen and thougth it to be probably indeterminable, but certainly did not belong to Dipterocarpaceae.

Trimen stated that the species could not be found.

Meyer's contention, that the *Vateria* fruit resembles that of *Vatica subcordata* or *Vatica papuana*, is wrong. His mistake is based on the fact, that he had only immature fruit at his disposal (cf. the drawings in his article).

Vateria is certainly very near to Vatica and there is no concensus whether these two genera should be fused or kept separate.

Thwaites (in the addendum of his Enumeration of Ceylon plants referred *Vateria* to *Stemonoporus*, perhaps influenced by the authority of Bentham and Hooker f.

Kandy District, Ambagamuwa, without collector, *C.P. 1918* (K, PDA); Peradeniya Bot. Gard., without collector (PDA); Hantane Estate, Kandy,

Worthington 6133 (BM); Imboolpitiya, Nawalapitiya, *Worthington 112* (BM); Nawalapithiya, Ginigathena road, mile 1, *Ashton 2001* (PDA); *Balakrishnan 1180* (PDA); Kolugala, Tumpane valley, *Worthington 1474* (BM); Nawalapitiya, mile 23, *Kostermans 24048* (PDA); Galle Distr., Galle, no collector, *C.P. 1918* (K, PDA); Kanneliya For. Reserve, *Ashton 2044* (PDA); *Meyer 548* (PDA); Bentota, *Worthington 2476* (BM); Ratnapura Distr., Induruwa (Gilimale), *Worthington 6464* (BM); Colombo Distr., Labugama Catchment area, *Ashton 2058* (PDA); *Worthington 3474* (BM); Wagga, Awisawelle, *Ashton 2061* (PDA); Awisawelle, *Meyer 394, 395* (PDA); Indikade, *Wijesinghe 50, 51* (PDA); Kegalle Distr., Ballahele, Kelani valley, *Worthington 2102* (BM); locality not indicated, C. *Paulett s.n.* (K).

Excluded species

1. *Vateria acuminata* Thw. = *Stemonoporus acuminatus* (Thw.) Bedd. (syn.: *Vatica acuminata* DC).
2. *V. affinis* Thw. = *Stemonoporus affinis* Thw. (syn.: *Vatica thwaitesii* DC).
3. *V. canaliculata* Thw. = *Stemonoporus canaliculatus* Thw. (syn.: *Vatica canaliculata* DC).
4. *V. ceylanica* Wight = *Stemonoporus ceylanicus* (Wight) Alston (syn.: *Vatica wightii* DC).
5. *V. cordifolia* Thw. = *Stemonoporus cordifolius* (Thw.) Alston (syn.: *Monoporandra cordifolia* Thw.)
6. *V. disticha* Thw. = *Doona oblonga* Thw. (syn.: *Vatica disticha* DC).
7. *V. elegans Thw.* = *Stemonoporus elegans* (Thw.) Alston (syn.: *Monoporandra elegans* Thw.).
8. *V. flexuosa* Lour. = ?
9. *V. gardneri* (Thw.) B.H. = *Stemonoporus gardneri* Thw. (syn.: *Vatica gardneri* DC).
10. *V. jucunda* Thw. ex Bedd. f. = *Stemonoporus acuminatus* (Thw.) (syn.: *Vatica acuminata* DC).
11. *V. lanceaefolia* (Thw.) A.DC. = *Stemonoporus lancifolius* (Thw.) Alston (syn.: *Monoporandra lanceaefolia* "Thw." A.DC).
12. *V. lanceolatus* Thw. = *Stemonoporus lanceolatus* Thw. (syn.: *Vatica lanceolata* DC).
13. *V. lanceolata* Wall. = *Vatica lanceolata* Bl.
14. *V. lancifolia* = *Stemonoporus lancifolius* (Thw.) Thw. Ashton (syn.: *Monoporandra lancifolia* Thw.)
15. *V. lewisiana* (Trim. ex Hooker f.) Alston = *Vatica lewisiana* (Trimen ex Hooker f.) Livera
16. *V. moonii* Thw. = *Stemonoporus moonii* Thw. (syn.: *Vatica moonii* DC); by Ashton referred to Sterculiaceae or Euphorbiaceae.
17. *V. nitida* (Thw.) B. & H. = *Stemonoporus nitidus* Thw. (syn.: *Doona nitida* (Thw.) Heim).
18. *V. oblongifolia* Thw. = *Stemonoporus oblongifolius* Thw. (syn.: *Vatica oblonga* DC).
19. *V. pauciflora* Walpers = *Vatica pauciflora* DC.
20. *V. petiolaris* Thw. = *Stemonoporus petiolaris* Thw. (syn.: *Vatica petiolaris* DC).
21. *V. reticulata* Thw. = *Stemonoporus reticulatus* Thw. (syn.: *Vatica reticulata* DC).

22. *V. rigida* Thw. = *Stemonoporus rigidus* Thw. (syn.: *Vatica rigida* DC).
23. *V. roxburghiana* Wight = *Vatica roxburghiana* Thw., Bl.
24. *V. scabriuscula* Thw. = *Sunaptea scabriuscula* (Thw.) Trimen (syn.: *Vatica scabriuscula* DC).
25. *V. thwaitesii* Ashton (sphalm.) = *Vatica thwaitesii* DC.
26. *V. wightii* Thw. = *Stemonoporus ceylanicus* (Wight) Alston (syn.: *Vatica wightii* DC).

5. *Hopea* Roxburgh

Hortus Bengal. 42. 1814 (nomen nudum); Pl. Coromandel. 3: 7. 1811 (nomen gener. conservandum, non L. 1767); Endlicher, Genera Pl. 1014. 1840 (*Hoppea*); DC., Prodr. 16(2): 632. 1868; Dyer in Hooker f., Fl. Brit. Ind. 1: 308. 1874; Burck, Ann. Jard. Bot. Buitenz. 6: 235. 1887; Heim, Recherches Dipter. 59. 1892 (including sect. *Hancea* (Pierre) Heim, l.c. 62); Brandis, J. Linn. Soc. Bot. 31: 53. 1895; Foxworthy, Philipp. J. Sci. 67: 273. 1938; Symington, Malay. Forest Rec. 16: 108, f. 67 (maps). 1943; Ashton, Gard. Bull. Singap. 20: 254. 1963; Manual Dipter. Brunei 89. 1964; Suppl. 37. 1968; Blumea 20: 359. 1972; Gard. Bull. Singap. 31: 28. 1978; in Fosberg & Dassanayake, Revised Handb. Fl. Ceylon 1: 375. 1980 (excluding *H. brevipetiolaris* (Thw.) Ashton); in Fl. Malaysiana, Ser. I, 9(2): 391. 1982; Meyer & Wood, Sabah Forest Rec. 5: 203. 1964; Gutierrez, Act. Manilla 4 A (2): 3. 1968; Maury-Lechon, Du fruit à la plantule, Thesis 1A: 55, 71, 89 (embryo), 122 (seedling), 178 (epidermis, stomata), 1B: 266 (anatomy). 1978; Smitinand, Thai Forest Bull. (Bot.) 12: 42. 1980; Kostermans, Ceylon J. Sci. (Biol. Sci.) 15(1–2): 41. 1982. — *Neisandra* Rafinesque, Sylva Tellur. 163. 1838. — *Petalandra* Hasskarl, Catal. Hort. Bogor. 104. 1858. — *Balanocarpus* Beddome, For. Man. Bot. 236 bis. 1873, p.p.; Heim, Rech. Dipt. 77. 1892 (p.p. quoad sect. *Sphaerocarpae* Heim, l.c.); Symington, Malay. For. Rec. 16: 147. 1943, p.p.; Ashton, in Fl. Mal., l.c. 391. — *Hancea* Pierre, Fl. for. Cochinch. 4: sub tab. t. 244. 1891. — *Pierrea* Heim, Bull. mens. Soc. Linn. Paris 2: 958. 1891 (nomen gen. conserv., non Hance). 1877. — *Dioticarpus* Dunn, Kew Bull. 1920: 337. —*Pierrocarpus* Ridley ex Symington, Gard. Bull. Straits Settl. 8: 30. 1934 (in synonym.) — *Doona* sensu Burck, Ann. Jard. Bot. Buitenz. 6: 233. 1887, p.p.; Ashton in Rev. Handb. Fl. Ceylon 1: 375. 1980.

Type species: *Hopea odorata* Roxb.

Small or large trees. Twigs often more or less pendulous. Leaves (Ceylon) with scalariform secondary nerves. Axillary and extra-axillary panicles with distichous, remote, rather few-flowered racemiform branches. Pedicels short. Stipules very small, fugaceous or sub-persistent. Sepals 5, slightly connate at base, the inner broader and thinner. Petals 5, slightly connate at base (falling in a rosette with the stamens) at anthesis explanate, apical part obliquely enrolled, the tips sticking out as spokes of a wheel. Indumentum of stellate scale-like hairs and simple hairs. Stamens 15 (outer row of 10), very small, the filaments consisting of a thin, flat, triangular basal and a filiform upper part. Anthers sub-globose, the 2 outer pollen sacs somewhat larger than the 2 inner ones, very small connectival appendage extremely thin, simple, 1–4 times the length of the anther. Ovary glabrous, merging into the slender, conical, equaly long style with punctiform stigma. Fruit (nut) similar to that of

Shorea, elongate-ovoid, strongly apiculate, included in the calyx lobes. Three calyx lobes ovate, acute, fleshy, base thickened; two lobes bearing long reticulate erect wings, spathulate and much narrowed at their insertion, Cotyledons slightly unequal, conduplicate, bilobed, not plicate (Trimen), pericarp splitting irregularly at germination (Ceylon), cotyledons photosyntetic; first pair of leaves opposite, followed by a whorl of 3 or spiral leaves (Ashton).

DISTRIBUTION: About 102 species (in Ceylon 4 species), Andamans, S. & E. India, Burma, Thailand, tropical China (Yunnan, Guangsi, S. Guantung, Hainan), Malesia (84 species), except the Lesser Sunda Islands.

ECOLOGY: Canopy or understorey, rarely emergent trees of lowland, wet, evergreen tropical forest also semi-evergreen forest. In Ceylon scattered or in small populations.

USES: Few species grow to timber size producing a heavy timber. In Malesia a cristaline resin was formally of importance.

NOTE: Sections are ill-defined (Ashton); several species share characters in more than one section.

Pollination in Malesia species is effected by Thrips.

Triploidy is known in both emergent or understorey species in Malesia, which might explain the high degree of endemics and the curious local diversification in New Guinea (Ashton).

Key to the species

1. Underside of the leaves with a dense layer of copper-red, tiny scales ..... 1. *H. discolor*

1. Underside of mature leaves glabrous

2. Leaf base deeply cordate. Flowers yellow. Species of gallery forests in the dry zone 2. *H. cordifolia*

2. Leaf base rounded or rounded-broadly cuneate. Flowers dark or light red. Trees of the Wet Zone.

3. Leaves 1.5 × 3 – 3 × 8 cm, underside smooth or secondary nerves very obscure. Petals 5–7 mm long. Connectival appendage 1 mm long. Fruit wings 4 cm long 4. *H. modesta*

3. Leaves 3 × 6 – 6 × 12 – 15 × 11 cm, underside with thin but distinct secondary veins, Petals 8– 10 mm long. Connectival appendage 2 mm long. Fruit wings 8 cm long ..... 3. *H. jucunda*

1. *Hopea discolor* Thwaites — Fig. 12

Enum. Pl. Zeyl. 36. 1858; A. DC., Prod. 16(2): 633. 1868; Dyer in Hook. f., Fl. Brit. India 1: 310. 1874; Trimen, Handb. Fl. Ceylon 1: 125. 1893; Alston in Trimen, Handb. Fl. Ceylon 6: 25. 1931; Brandis, J. Linn. Soc. Bot. 31: 57, pl. II, fig. 5, 6. 1895; Lewis, Trees & fl. Pl. W. and Sabaragamuwa Prov. 33. 1902; Veget. Prod. Ceylon 38. 1934; Worthington, Ceylon Trees 64. 1959; Ashton in Fosberg & Dassanayake (ed.), Revised Handb. Fl. Ceylon 1(2): 173. 1977; reprint 1: 378. 1980; Kostermans, Ceylon J. Sci. (Biol. Sci) 15

(1–2): 42. 1982; Nair & al., J. Econ. & Taxon. Bot. 3(3): 649. 1984. — Typus: Ambagamuwa, Eknaligoda, April 1855, fl., fr., sine collect. *C.P. 3125* (PDA).

Tree, up to 45 m tall and 130 cm dbh. Buttresses concave, rather thin, up to 2 m tall and 1.5 m out. Bark dark red-brown, deeply fissured, strips 2 cm wide, ridges flaky; outer bark dark brown with paler areas towards the rhytidome layer; inner bark red-brown, fibrous. Sapwood hard, dark straw-yellow; heartwood dark brown (Ashton). Twigs slender, much branched, microscopically coppery lepidote, becoming black. Leaf buds minute. Leaves ovate-lanceolate, coriaceous, 1.5 × 4 – 3.5 × 8 cm, gradually caudate-acuminate (acumen up to 2 cm, obtuse), base rounded to broadly cuneately rounded; margins usually slightly recurved; above smooth, glabrous, midrib impressed, thin, lateral nerves very thin, impressed; below conspicuously coppery, dark brown-red lepidote (scales microscopical), midrib prominent; lateral nerves 5–7 pairs, rather erect, slightly arcuate (apical ones more), thin, prominulous; secondary nerves obscure, parallel, all horizontal. Petiole slender, canaliculate above, lepidote, 6–13 mm long. Stipules thick, narrowly oblong, acute, curved and folded, glossy, c. 2 mm long, sub-persistent. Panicles 1–3, axillary, up to 5 cm long with few, up to 1 cm long, erect branches, each with c. 3 pinkish yellow flowers. Buds ovoid. Sepals thick, ovate-triangular, acute, 1.5–2 mm. Petals oblong-ovate, 4 mm, outside densely subsericeous (coarse hairs). Stamens 15, 1 mm long, very slender, basal part of filament elongate, triangular, flat, upper part filiform. Anther 0.25 mm long, connectival appendage very thin, slightly longer than anther or twice as long. Ovary glabrous, conical stylopodium pilose, style glabrous, stigma punctiform. Nut elongate-ovate, acute, up to 7 × 10 mm, apiculate, apex visible; 3 sepals ovate, acute, fleshy, 1 cm long, two transformed into narrow wings 6 cm long. Wings sub-sphatulate, conspicuously longitudinally veined and reticulate, obtuse, 6 cm long, 1–1.25 cm wide.

DISTRIBUTION: Endemic. Not uncommon but very scattered in the S.W. part of rainforest in Ceylon, up to Eknaligoda and Bambarabotuwa reserve in Southern Adam's Peak Jungle, Kuruwita, Kaneliya forest, etc.

ECOLOGY: Not connected with any type of soil, deep or shallow soils, all somewhat acid in this area, up to 600 m alt.

NOTES: The note, of Ashton, that *C.P. 2970* should have been enumerated in the original description is wrong. It is mentioned by Trimen, not by Thwaites. Hence his proposition for a lecto-type is superfluous. The type (PDA) consists of 2 sheets, both from Eknaligoda, one collected August 1855, the other April 1855 (holo), both in flower, the one of April 1855 has a package of detached fruit (holo-type).

Sapling stages were not lepidote and have leaves up to 4 × 11 cm.

The timber is soft (Worthington).

There is no proper local name for this tree; Rat Doon is a collector's invention (rat, rattu=red).

Ratnapura District: Eknaligoda, April 1855, fl., fr., *sine. coll. C.P. 3125* (PDA); Aug., fl., *s. coll., C.P. 3125* (PDA); Kiribatgalle near Pelmadulla,

sapling, *Ashton 2118, 2119* (PDA); Karawita Kande, ster., *Ashton 2261* (PDA); Bambarabotuwa For. Res., N. of Pelmadulla, alt. 500 m, ster., *Meijer 401* (PDA); Galle District: Hinidumkande, ster., *Worthington 2288* and *2289* (BM); Kanneliya forest, alt. 200 m, ster., *Meijer 560* (PDA); Sinharaja For., Weddagalle entrance, ster., *Gunatilleke 3399* (PDA); *Kostermans s.n.* (L).

12. *Hopea cordifolia* (Thw.) Trimen — Fig. 13

Trimen, Handb. Fl. Ceylon 1: 126. 1893; Alston in Trimen, Handb. Fl. Ceylon 6: 25. 1931; Brandis, J. Linn. Soc. Bot. 31: 58. 1895; Lewis, Trees & fl. Pl. W. and Sabaragamuwa Prov. 34. 1902; Lewis, Veget. Prod. Ceylon 39. 1934; Worthington, Ceylon Trees 63. 1959; Ashton in Fosberg & Dassanayake (ed.), Revised Handb. Fl. Ceylon 1(2): 173. 1977; reprint 1: 377. 1980; Kostermans, Ceylon J. Sci. (Biol. Sci.) 15(1–2): 44. 1982. — Typus: C.P. 3726 (PDA).

Vatica cordifolia Thw., Enum. Pl. Zeyl. 404. 1864; A. DC., Prod. 16(2): 622. 1868; Dyer in Hook. f., Fl. Brit. India 1: 303. 1874 (exclud. cit. Thw. p. 39); Trimen, l.c.; Ashton, ll. cc.

Isauxis cordifolia Hook. f., Fl. Brit. India 1: 722. 1875 (in Index); Ashton, ll. cc. — Typus: Atakalan Corle (Korale), ster., *C.P. 3726* (PDA).

Tree, up to 30 m tall and 100 cm dbh. Buttresses low, rounded. Crown dense. Bark light brown, in older trees flaky in small pieces, fissured, outer bark thick, dark brown, paler near the rhytidome layer. Sapwood hard, dark yellow, heartwood chocolate brown (Ashton). Branchlets rather slender, densely, minutely light brown pubescent (hairs upright); terminal bud small, densely puberulous. Leaves glabrous, coriaceous, subovate-oblong, 3 × 9 — 12 × 21 cm, gradually sub-acuminate or acute (acumen broad, up to 3 cm long, obtuse), base very much cordate, both sides glossy and minutely densely reticulate; above midrib and the thin lateral nerves slightly prominulous; below midrib prominent, lateral nerves erect-patent (basal ones patent), arcuate towards the margin, slender, prominent, a few axills with pits, secondary nerves faint, scalariform, widely spaced. Petioles up to 2.5 cm long, densely puberulous (hairs minute, erect), stout, shallowly narrowly channeled above. Stipules very small, subulate, caducous. Panicles 1–3, axillary, erect, up to 10 cm long, branches few, up to 5 cm long, raceme-like with up to 8 pale yellow flowers. Pedicels thick, pilose, up to 2 mm long. Sepals fleshy, erect, ovate-triangular, acute, up to 3 mm long, glabrous. Petals ovate-oblong, densely sericeous outside, 5 mm long, top obliquely enrolled, at anthesis explanate with a tiny central hole, the basal half, erect. Stamens 15, minute, 1.5 mm long with broadly triangular basal part of filament, upper part filiform. Anther 0.5 mm long with up to 2 mm long very thin hyaline bristle appendage. Ovary glabrous, ovoid-conical, merging into the glabrous, twice as long style with punctiform stigma. Nut completely included in the calyx, narrowly ovoid, prominently apiculate, up to 7 × 12 mm, the 2 longer, winglike sepals subsphatulate, obtuse, up to 10 cm long, 3 cm wide, strongly, veined, the 3 shorter, thickened ones ovate, acute, 1 cm long.

DISTRIBUTION: Endemic. Gallery forests in the dry zone in the Uva, along Walawe and Kirindi Oya and their tributaries.

ECOLOGY: Gallery forests species, alt. c. 100 m.

NOTES: Leaf venation resembles strongly that of Ceylon *Vatica* species (hence Thwaites' generic guess) and also *Balanocarpus bravipetiolaris*. It flowers in April and October, not regularly (contrarily to Ashton's contention). It has little resin.

The combination *Hopea cordifolia* was published by Trimen with an interrogation mark as he was not sure about the genus, although he had examined some old fruit.

Moneragala District: Wellawaya Rd. near Doonking, Sept. 1857, ster., *s. coll. C.P. 3726* (PDA); crossing Highway A 2 and Kirindi Oya at mile 183/2, c. 15 miles S. of Wellawaya, Oct., fl., *Davidse 7759* (PDA); Kirindi Oya, Tanamalwila, Uva, young fr., July 1896, *Broun s.n.* (PDA); April 1912, fl, *Lewis s.n.* (PDA); Aug., young fr., *Lewis s.n.* (PDA); ibid., ster., *Meijer 1901* (PDA); *Ashton 1079, 1080, 1081* (PDA); May, young fr., *Kostermans 28478* (AAU, G, L, PDA); May, fl., *Balasubramanian 2499* (L, PDA); Uda Walawe, ster., *Balakhrisnan et al. 898* (PDA). (locality of Lewis reconstructed from his letter, attached to one sheet).

3. *Hopea jucunda* Thwaites — Fig. 14, 14a, 14b

Enum. Pl. Zeyl. 403. 1864 (exclud. forma *foliis minoribus*); A.DC., Prod. 16(2): 633. 1868 (exclud. var. *modesta* A.DC); Dyer in Hook. f., Fl. Brit. India 1:310. 1874 (exclud. var. *modesta*); Trimen, Handb. Fl. Ceylon 1:125. 1893 (exclud. var. *modesta*); Brandis, J. Linn. Soc. Bot. 31: 57. 1895; Lewis, Trees & Fl. Pl. W. and Sabaragamuwa Prov. 33. 1902; Lewis, Veget. Prod. Ceylon 33. 1934; Worthington, Ceylon trees 65. 1959; Ashton in Fosberg & Dassanayake (ed.), Revised Handb. Fl. Ceylon 1(2): 174. 1977; reprint 1: 379. 1980; Kostermans, Ceylon J. Sci. (Biol. Sci.) 15 (1–2): 44. 1982; Nair & al., J. Econ. & Taxon. Bot. 3(3): 649. 1984. — Typus: C.P. 3709 (PDA).

Hopea jucunda subspec. *jucunda* Ashton, ll. cc. (exclud. *C.P. 2970*, quoad *H. modesta*) — Lectotypus propositum: Hewesse, Marapalai, April 1861, fl., *C.P. 3709* (PDA); syntypus: Hewesse, May 1861, fl., *C.P. 3709* (PDA).

Tree, up to 20 m tall and 30 cm dbh. Bole often short, sometimes fluted. Buttresses none or numerous, small and thick. Bark greyish, smooth, in old trees flaky; inner bark pale brown. Sapwood pale yellow, heartwood light brown. Branchlets slender, sometimes somewhat pendulous, densely very minutely pilose (hairs erect), soon glabrous. Flush leaves puberulous on both sides. Leaves glabrous, chartaceous to sub-coriaceous, ovate-elliptic to ovate-orbicular, 3 × 6 – 6 × 12 – 5 × 11 cm, conspicuously caudate-acuminate (acumen obtuse, slender up to 2.5 cm), base rounded to rounded-subcuneate; above smooth, rather dull, midrib flush with the surface (upper part impressed), lateral nerves thin, somewhat impressed; below paler, midrib prominent, the 3–4 pairs of prominent lateral nerves arcuately ascendent, axils with hairy pits; secondary nerves numerous, faint, parallel, all almost horizontal. Petiole slender, soon glabrous, 5–12 mm long, in older leaves transversely cracked. Panicles glabrous, 1–3 axillary or extra-axillary, up to 11 cm long with remote, racemiform, distichous, up to 2 cm long branches, each with 1–4 flowers. Pedicels thick, 1.5 mm long. Sepals fleshy, broadly ovate, acutish or obtuse, 2–4 mm long, inner ones broader and thinner.

Petals explanate, dark red, lanceolate, acutish, 8–10 mm long, outside densely sericeous, tips slightly widened, thin, white. Petals falling in a rosette. Stamens minute, 15, 1.5 mm long, basal part of filament broad, upper part filiform. Anther globose, 0.5 mm long, connective appendage very thin, 2 mm long. Ovary ovoid, merging into the glabrous, narrowly conical, equally long style with punctiform stigma. Fruit: Two wings sphatulate, obtuse, up to 8 cm long, 2,5 cm wide, narrowed at the base to 5 mm wide. Unwinged sepals fleshy, glossy, bases very thick, ovate, acute, concave, up to 6 × 10 mm, sometimes resin coated.

DISTRIBUTION: Widely scattered in the wet zone from Kitulgalle southwards.

ECOLOGY: In small groups or solitary on deep and shallow soils, can stand some drought. Flowering once or twice a year, sometimes with long intervals.

NOTE: The lecto-type specimen has a package of young fruit; these were not described by Thwaites. Lewis (Veget. Prod., l.c.) and Worthington call the flowers wrongly white; they are dark red and hence the name Ratberiliya (rat=ratu=red).

Ashton calls the variety *modesta* an ecotype subspecies, which it is certainly not; it occurs in exactly the same areas and on the same soils as *H. modesta*. It is less common than *H. modesta*.

It differs from *H. modesta* by the twice as large leaves, twice as large flowers and three times as large fruit. Brandis gives some other minor differences (cf. under *H. modesta*).

The very characteristic white, broadened thin tip of the petals has so far been overlooked.

Kegalle District: Kitulgalle, 15–500 m, ster., *Ashton 2004* (PDA); *Cramer 4404* (PDA); across Kelaniya R. near Kitulgale, 200 m, Apr., fl., *Kostermans 28351* (AAU, G, L, PDA); ridge top, April, fl., *Kostermans 28344* (id.); Colombo District: Labugama Catchment area, 100 m. alt., ster., *Ashton 2057* (PDA); Ratnapura District: Sinharaja Forest, Weddegalle entrance, alt. 100 m, ster., *Ashton 2029* (PDA); *Meijer 904* (PDA); Galle District: Nellowe-Pelawatte Road, alt. 100 m, ster., *Ashton 2067* (PDA); Kanneliya Forest Res., 150 m. alt., ster., *Ashton 2042*; Hewesse, Marapalai, fl., fr., April 1861, *s. coll., C.P. 3709* (PDA); Kalutara District: Hewesse, May 1861, fl., *C.P. 3709* (PDA); s. loc., fl., *C.P. 3709* (PDA); Kandy District: Botanic Garden, Peradeniya, April, fl., *de Silva 81* and *Livera s.n.* (PDA); June young fr. *de Silva 62* and *70* (PDA); ripe fr., July, *Lewis s.n.* (PDA); April, fl., *Kostermans 28221* and *28243* (G, AAU, L, PDA); May, fl., *Kostermans 28293* (G, AAU, L).

4. *Hopea modesta* (A. DC.) Kosterm. — Fig. 15, 15a

Ceylon J. Sci. (Biol. Sci.) 15(1–2): 47. 1982. — Typus: C.P. 3710 (PDA).

Hopea jucunda var. *modesta* A. DC., Prod. 16(2): 633. 1868; Dyer in Hook. f., Fl. Brit. India 1:310. 1874; Trimen, Handb. Fl. Ceylon 1: 125. 1893; Brandis, J. Linn. Soc. Bot. 31: 58. 1895 (sphalm. as *Hopea modesta*

DC); Lewis, Trees and fl. Pl. W. and Sabaragamuwa Prov. 34. 1902; Veget. Prod. Ceylon 39. 1934.

Hopea jucunda, subspec. *modesta* (DC.) Ashton in Fosberg & Dassanayake (ed.), Revised Handb. Fl. Ceylon 1(2): 174. 1977; reprint 1: 380. 1980.

Hopea jucunda forma *foliis minoribus* Thw., Enum. Pl. Zeyl. 403. 1864. — Hewesse, March 1861, buds, *C.P. 3710* (PDA).

Hopea jucunda subspec. *jucunda* Ashton, l. c., quoad specimen *C.P. 2970* (PDA), fruits only.

Shorea ovalifolia Auct. (non Ashton) Ashton in Fosberg & Dassanayake (ed.), Revised Handb. Fl. Ceylon 1(2): 185. 1977; reprint 1: 401. 1980, quoad specim. *Ashton 2066*.

Tree, up to 10 m tall and 30 cm dbh. Buttresses inconspicuous. Bole slightly fluted at base. Bark smooth, purplish brown, thin; wood hard, yellowish, rather heavy. Branchlets slender, long, pendulous, densely, very minutely puberulous (hairs erect). Leaves chartaceous, ovate-elliptic, rarely orbicular-elliptic, 1.5 × 3 – 3 × 8 cm, long-caudate, acuminate (acumen up to 1.5 cm, slender, obtuse), base rounded or rounded-broadly-subcuneate, both surfaces smooth; midrib above level with surface or slightly impressed apically, lateral nerves very thin, somewhat impressed; midrib beneath slender, prominent, the 3–4 pairs of lateral nerves thin, arcuately ascendent; secondary nerves none. Petiole slender, 5–8 mm long, smooth, glabrescent. Panicles filiform, almost glabrous, axillary and extra-axillary, up to 9 cm long with few, distichous, filiform racemiform branches, up to 1,5 cm long. Pedicels thick, 1 mm. Sepals broadly ovate, 2.5 mm, obtuse. Petals dark red or light red, lanceolate, 5–7 mm long, outside densely sericeous (stellate scales plus hairs). Stamens 15, minute, connectival appendage 2 × the length of the anthers (c. 1 mm). Ovary glabrous, merging into the slender, as long, conical style. The two fruit wings sphathulate, 2 × 4 cm, at base 2–3 mm wide. The other sepals ovate, acute, glossy, swollen at the base. Nut oblong-ovoid, apiculate, up to 3 × 5 mm.

DISTRIBUTION: In the entire area of wet, tropical rainforest, up to 1000 m alt., from Kitulgale southwards.

ECOLOGY: Same as that of *H. jucunda*, also very scattered and occuring on deep and on shallow soils, can stand long droughts.

NOTE: Originally described as a form of *H. jucunda*, raised to varietal rank by de Candolle and by Ashton to subspecific rank.

Brandis pointed out already some differences from *H. jucunda*: the much smaller leaves, the panicles much longer than the leaves with filiform rachis and branches, the flowers being only half as large as those of *H. jucunda*.

The fruit are likewise only half the size of those of *H. jucunda*, the secondary nerves on the lower leaf surface are either absent or extremely faint.

Both species occur in the same area and do not seem to cross. It is called Pini Beraliya in Hewesse as the leaves resemble those of *Memecylon arnottianum*, well known Pini baru. Also *Doona ovalifolia* with similar leaves is called Pini Beraliya.

The tree seems not or rarely to reach timber size.

Ashton raised it to subspecific rank, but wrongly attributed this to de Candolle. Ashton's description of *Shorea ovalifolia* was based in part on his sterile collection *Ashton 2066* (PDA), which is *Hopea modesta*. His ecological remarks on *Shorea ovalifolia* refer to *H. modesta*, which indeed can grow under drier conditions than other Dipterocarpaceae. The seedlings (*Ashton 2066*) have hairy branches, hairs erect).

C.P. 2970 (detached fruit and a single leaf) is enumerated in Thwaites' Catalogue as *C.P. 2970 (= 3215)*, without identification. The fruits are those of *H. modesta* (not *jucunda*, as Ashton stated); the leaf is unidentifiable.

Kandy District: W. of Double Cutting Junction, 800 m alt., March, fl., *Jayasuriya 1582* (PDA). Galle District: Hiniduma, Hinidumkande, sapling, *Cramer 3083*; Ithandukita, near Nellowe, ster., *Ashton 2066* et a (seedling) (PDA); Nellowe-Pelawatte Rd., 100 m alt., pole tree, *Ashton 2077 & 2093* (PDA); Kottawa Arboretum near Galle, Febr., fl., *Jayasuriya 1546* (PDA); Kanneliya For. Res., 150 m alt., ster., *Meijer 970* and *Waas 555* (PDA). Kalutara District: Hewesse, March 1861, buds, *s. coll., C.P. 3710* (PDA); Hewesse, Linigalle, March 1887, buds, *s. coll. s.n., C.P.* (PDA). Ratnapura District: Karawita For. Res., Nawadun Korale, 400 m alt., ster., *Ashton 2136* (PDA); Kandy District: Botanic Garden, Peradeniya, July, fr., *Kostermans 27736* (PDA); March, fl., *Kostermans 28214* (AAU, G, L, PDA); April, fl., *de Silva 61* (PDA); June, fr., *de Silva* 64 (PDA).

6. *Shorea* Roxb. ex Gaertner f.

De Fructibus et Seminibus 3: 48. 1805; Roxburgh, Fl. Coromand. 3: t. 212 B. 1815; Benth. & Hooker f., Gen. Pl. 1: 193. 1862; A. DC., Prodr. 16(2): 628. 1868; Dyer in Hooker f., Fl. Brit. Ind. 1: 303. 1874; Burck, Ann. Jardin Bot. Buitenz. 6: 204. 1877; Heim, Recherches Dipter. 36. 1892 (including sect. *Anthoshorea* Heim, l.c. 41, sect. *Hopeoides* Heim, l.c. 43, sect. *Pachynocarpus* Heim, l.c. 44, sect. *Richetioides* Heim, l.c. 48); Brandis, J. Linn. Soc. Bot. 31: 73. 1895 (including sect. *Pinanga* Brandis, l.c. 90, sect. *Mutica* Brandis, l.c. 100); Foxworthy, Philipp. J. Sci. 67: 290. 1938 (including sect. *Isoptera* (Scheffer ex Burck) Foxw., l.c. 291, 301); Symington, Malay. For. Records 16: 1. 1943; Meyer, Acta Bot. Neerl. 12: 322. 1963 (including subgen. *Richetia* (Heim) Meyer, nomen invalid., subgen. *Rubroshorea* Meyer, l.c. 322); Ashton, Gard. Bull. Singapore 20: 261. 1963 (including sect. *Neohopea* Ashton, l.c. 266, sect. *Rubella* Ashton, l.c. 267, sect. *Ovalis* Ashton, l.c. 268); Manual Dipter. Brunei 115. 1964; Suppl. 60. 1981; Blumea 20: 360. 1972; Gard. Bull. Sing. 31: 36. 1978 (including sect. *Pentacme* (A. DC.) Ashton, l.c. 38); in Fosberg & Dassanayake (ed.), Revised Handb. Fl. Ceylon 1: 381. 1980 (excluding *Doona* Thw.); in Flora Malesiana, Ser. I, 9(2) 436. 1982 (excluding *Doona* Thw.); Meyer & Wood, Sabah Forest Rec. 5: 48. 1964; Smitinand, Thai Forest Bull. (Bot.) 12: 57. 1980; Kostermans, Botan. Jahrb. Syst. 104(2): 183–201. 1983. — *Pentacme* A. DC., Prodr. 16(2): 626. 1868; Brandis, J. Linn. Soc. Bot. 31: 361. 1972; Sym., Mal. For. Rec. 18: 104, f. 63 (map). 1943; Ashton in Fl. Mal., l.c. 435. — *Isoptera* Scheffer ex Burck, Mededeeling. 'sLands Pl. tuin Buitenz. 3: 27. 1885; Brandis, J. Linn. Soc. Bot. 31: 105. 1895; Ashton, Fl. Mal., l.c. 437. — *Ridleyinda* O. Kuntze, Revis. Gen. Pl. 1: 65. 1891; Ashton, Fl. Mal., l.c. 437. — *Richetia* Heim, Bull. mens. Soc. Linn. Paris 2: 975. 1891; Ashton, Fl. Mal., l.c. 437. — *Anthoshorea* Pierre ex Heim,

Recherches Dipter. 41. 1892 (nomen in syn.); Ashton, Fl. Mal., l.c. 437. — Parahopea Heim, l.c. 66; Ashton, l.c. 437. — *Pachychlamys* (Dyer ex King) Dyer ex Ridley, Fl. Malay Penins. 1: 233. 1922; Ashton, l.c. 437. — Type species: *Shorea robusta* Roxb.

Medium sized or large, more or less buttressed trees. Mature crown large, hemispherical or dome-shaped, sympodial. Bark surface (Ceylon species) flaky or fissured. Inflorescence paniculate, flowers secund. Sepals free to the receptacle, the 3 outer lobes thicker, somewhat longer and narrower than the 2 inner lobes in flower. Petals usually connate at base on falling (excluding sect. subsect. *Shorea*). Stamens 10 to many; filaments applanate, more or less tapering; anthers subglobose to narrowly oblong, glabrous (Ceylon species), sometimes apiculate, appendage long and acicular. Ovary with a style with or without stylopodium.

Fruit sepals accrescent and aliform, the 3 outer longer and broader than the inner, or short and subequal; base of lobes thickened, expanded, saccate, appressed to the fruit. Nut free, pericarp splitting irregularly at germination. Germination various. Unicellular scales, if present, broad-lobed.

DISTRIBUTION: About 194 species in Sri Lanka, India, Burma, Thailand, Indochina and 163 species in Malesia up to the Philippines and Isl. Buru, not in New Guinea. In Ceylon 6 species.

Fossil wood has been identified as *Shoreoxylon* from Timor of the Lesser Sunda islands by Schweitzer (Palaeontographica 105 B: 1—66. 1959); *Shorea* does not occur in Timor nowadays.

Occurence up to 1750 m. The most common and important timber trees of Malesia. There are heavy and hard timbers, to light soft ones.

ECOLOGY: Dominating the emergent canopy of the wet zone forests. None flowers annually and each has its own flowering time; perodicity, though sporadic flowering occurs every year, certain years with heavy, gregarious flowering. Most of the fruits are eaten by parakeets, squirels, pigs and destroyed by termites and fungi on the ground. Occurence is scattered.

VERNACULAR NAMES: Typical names for species.

NOTE: The six (endemic) species of *Shorea* are not a homogeneous group. *Shorea dyeri, S. oblongifolia, S. pallescens, S. stipularis* and *S. hulanidda* are large to very large trees with fruit with well-developed wings. *Shorea pallescens* is aberrant within the group because of its petals falling separately (the others in a rosette, as a whole). Moreover *Shorea stipularis* and *S. hunalidda* have only 15 stamens, the others 60—80. It does not seem possible or advisable to have sub-divisions based on the number of stamens.

Much more aberrant is *Shorea lissophylla*, a much smaller tree, of which the sepals do not develope into wings and with 30 stamens; it was formerly considered to belong to *Isoptera*, a genus now incorperated in *Shorea*.

All species are lowland trees, not growing above 700 m altitude and are restricted to the everwet, very wet rainforest. None of them occurs gregariously, at their original distributional pattern is difficult to assess, as they are (with accception of *S. lissophylla*) prime timber trees and their numbers must have been decimated considerably. *Shorea dyeri*, the tallest of

all, occurred even in the Uva Province (Lunugalle), an area already for centuries denuded of any forest vegetation.

The Shoreas occur in a not too wide belt in the western part of Ceylon's lowlands, from Colombo (eastwards to almost Kegalle) southward to the Sinharaja and Kanneliya forests and it is likely that they occured also in the Galle district. They do not occur in the Knuckles, neither in the Kurunegala district.

They are very scattered and prefer sites which are wet or moist throughout the year, with the exception of *S. lissophylla*, which apparently can stand water stress better; in rocky areas it has a crooked, stunted bole, but on better sites the bole is straight and symmetrical (a similar phenomenon is found in *Balanocarpus brevipetiolaris*).

The commonest species are now *S. oblongifolia*, *S. stipularis* and *S. hulanidda; S. dyeri* is now the rarest.

The genus *Doona* has been incorporated in *Shorea* by Ashton, but I disagree with this. The indumentum of *Shorea* is entirely different from that of *Doona* (stellate hairs and stellate scales versus simple hairs), and the connectival appendages of *Shorea* and *Doona* are likewise very different (setaceous verus bare, club-shaped). *Doona* is a very close-knit genus with characteristically fleshy, white or white and red inflorescences fleshy petals, and fruit wings which are always twisted like a propeller and fleshy, white in an immature stage.

Shorea oblongifolia is the only one tapped for resin. The resin is clear and used for pale varnishes. *S. stipularis* and *S. hulanidda* barks are used as a substitute for that of *Vateria copallifera*, used for checking the conversion of alcohol into acetic acid in toddy of the Toddy palm.

Key to the species

1. Calyx not developing into wings ..... 2. *S. lissophylla*

1. Calyx developing into wings 2

2. Stipules large, persistent at the apical part of the twigs; large bracts persistent in the inflorescence; stamens 15

2. Stipules fugaceous; stamens c. 60–80

3. Leaves very stiffly coriaceous, obtuse; stipules 2–3 × 1–2 cm, 12–16 mm wide; sepals 8 mm; petals 10 mm ..... 5. *S. stipularis*

3. Leaves coriaceous, acuminate; stipules 1 × 2 cm, sepals 4–5 mm; petals 5 mm ..... 6. *S. hulanidda*

4. Twigs densely, minutely grey stellate scaly ..... 1. *S. dyeri*

4. Twigs glabrous or with microscopic fimbriate scales

5. Midrib and lateral nerves impressed on the upper leaf surface; lateral nerves 8–14 pairs; lower leaf surface glabrous; panicles fimbriate-lepidote 3. *S. oblongifolia*

5. Midrib prominulous on the upper leaf surface; lateral nerves 6–8 pairs; lower leaf surface with amorphous grey material; panicles stellate-thin-hairy 4. *S. pallescens*

1. *Shorea dyeri* Thwaites — Fig. 16

Thwaites ex Trimen, J. Bot. 23: 204. 1885; Trimen, Handb. Fl. Ceylon 1: 117. 1893; Brandis, J. Linn. Soc. 31: 79. 1895; Worthington, Ceylon trees 50. 1959; Ashton in Fosberg & Dassanayake (ed.), Revised Handb. Fl. Ceylon 1(2); 176. 1977; reprint 1: 384. 1980; Kostermans, Bot. Jahrb. Syst. 104(2): 185, f. 1. 1983. — Typus: Sine collector, southern part of the island, fl., *C.P. 4010* (PDA).

Hopea discolor Auct. (non Thwaites) Worthington, Ceylon trees, l.c. 64; Ashton, ll. cc.

Tree, up to 60 m tall and 100 cm dbh. (Worthington). Buttresses thin, concave, frequently prominent (Ashton). Bark peeling in large, thick, jigsaw-like smooth plates. Terminal leaf bud small, compressed, covered by the minutely stellate-pilose, oblong, acutish, up to 3 × 7 mm long, fugaceous stipules. Twigs slender, more or less densely covered by minute, grey, stellate scales. Leaves chartaceous, oblong-ovate to lanceolate, 2 × 7 — 3 × 8 — 4 × 9 — 2.5 × 5 cm, usually broadly shortly acuminate, rarely gradually long-acuminate (acumen 5 — 20 mm long), base obtuse or truncate to broadly cuneately obtuse; above smooth, midrib thin, impressed, lateral nerves very thin, sub-impressed or level with the surface; below glossy, midrib slender, prominent, the 10 — 12 pairs of thin, erect-patent, near the margin arcuate lateral nerves prominent, connected by obscure, numerous, scalariform secondary nerves (not perpendicular to the lateral nerves), axils usually with hairy domatia. Petiole slender, initially densely stellate-lepidote, 1—1.5 cm long, channeled above.

Panicles axillary of the upper leaves or forming a compound terminal panicle up to 12 cm long, slender, many-flowered, open, broad, densely, minutely, stellate-lepidote. Branches slender, each with 1-6 flowers, densely stellate-lepidote. Flowers sessile or with thick, 1 mm long pedicels; bracts caducous. Sepals broadly ovate, triangular, acutish, thick, densely white-stellate-pilose, 2 mm long. Petals red (Thwaites), oblong, obtuse, 5 mm, outside very densely grey white appressed stellate-pilose (hairs very thin), inside glabrous, not twisted and hardly recurved. Stamens c. 60 on short triangular (upper half filiform) filaments; anthers elliptic, connectival appendage a branched, very thin, hyaline seta, slightly longer than the anther. Ovary densely, white appressed pilose, merging into a short, pilose stylopodium and very short thick style. Fruit pedicels 1 mm. Nut ovoid, apiculate, pilose, up to 8 × 10 mm (immature). Large wings up to 1.5 × 7.5 cm, narrowly spathulate, obtuse, veined; shorter ones 0.5 × 3.5 cm.

DISTRIBUTION: In all wet parts of the island, up to 700 m altitude. Also in the Uva.

NOTE: I had not much material at my disposal and I have not seen mature fruit.

South of the Island, fl., *C.P. 4010* (PDA); Nuwara Eliya Distr., Morahanagama, ster., *Waas 2284* (PDA); Colombo Distr., Labugama, June, y.fr., *Jayawardena 9828* (PDA); Kanneliya forest near Hiniduma, 200 m altitude, Apr., fl., *Waas & Peeris 556* (PDA); Bambarabotuwa For. Res, 700 m altitude, ster., *Ashton 2026, 2013* (PDA); Kalawana Road, mile 15, 150 m

altitude, ster., *Ashton 2025, Meyer 452* (PDA); Nellowe, 400 m alt., ster., *Ashton 2070* (PDA); Uva Prov., Lunugalle, ster., 1888 (PDA); Botanic Garden Peradeniya, Aug., y.fr., *P.W. de Silva 87* (July, fl., id. 75); June, buds, id. 65 (PDA).

2. *Shorea lissophylla* Thwaites — Fig. 17, 17a, 17b

Thwaites, Enum. Pl. Zeyl. 402. 1864: ibid. 36. 1858 (in note sub *S. stipularis*); A.DC., Prodr. 16(2): 630. 1868; Dyer in Hooker f., Fl. Br. Ind. 1: 307. 1874; Trimen, Handb. Fl. Ceylon 1: 117. 1893; Brandis, J. Linn. Soc. 31: 79. 1895 (nomen); Lewis, Trees and flow. Pl. W. & Sabaragamuwa Prov. 29. 1902; Veget. Prod. Ceylon 30. 1934; Worthington, Ceylon Trees 51. 1959; Ashton in Fosberg & Dassanayake (ed.), Revised Handb. Fl. Ceylon 1(2): 177. 1977; reprint 1: 385. 1980; Kostermans, Bot. Jahrb. 104(2): 186, f. 2. 1983; Nair & al., J. Econ. & Taxon. Bot. 3(3): 649. 1984. — *Isoptera lissophylla* (Thw.) Livera in Ann. Roy. Bot. Gard. Peradeniya 9: 93. 1924; Alston in Trimen, l.c. 6(suppl.) 23. 1931; Ashton, ll.cc. — Typus : Hiniduma Pattu, Nellowe, fl., Apr. 1864, *C.P. 3407* (PDA).

Tree, up to 20 m tall and 40 cm dbh. with straight cylindrical bole and rather small crown, no buttresses or in rocky places buttresses. Bark brown, rather smooth, not peeling. Twigs with lax to dense layer of minute, grey-fimbriate scales. Leaf buds flattened, rather small, covered by narrowly oblong, acutish, up to 3 × 8 mm long, fugaceous, thickish stipules. Leaves rigidly coriaceous, glabrous, ovate to ovate-oblong to ovate-orbicular, 6 × 9 – 7 × 8 – 9 × 15 – 10 × 11 (in saplings up to 10 × 18 cm), broadly, shortly acuminate (acumen 0.5 – 1.5 cm long), base cordate, obtuse or truncate; above glossy green (fresh), smooth or obscurely densely veined to pitted, midrib impressed, lateral nerves thin, impressed; below somewhat paler, midrib strongly prominent, lateral nerves slender, prominent, erect-patent, near the margin arcuate, 5 – 8 pairs (lower ones sub-quintuplinerved), secondary nerves obscure, scalariform. Petiole thin or thick, 1 – 2 cm, channeled above, initially densely, minutely fimbriate-lepidote.

Panicles axillary and extra-axillary, up to 15 cm long, slender, densely to laxly minutely grey-fimbriate-lepidote, branches few, up to 3 cm long, racemiform, with at one side 2–6 flowers. Flowers yellowish, inside base purplish. Pedicel densely to laxly fimbriate lepidote (hairs longer than those of the branches), ovate or ovate-suborbicular, acute, 2 mm; inner ones fimbriate. Petals yellowish to white, linear-lanceolate, densely grey sericeous outside, 10–12 mm long, 2–15 mm wide, obtuse, not connected at the base. Stamens free, c. 30, 1.5 mm long, filaments 0.75 mm long, basal part broadly elliptic, dark, upper part filiform; anther 0.75 mm, narrowly oblong, cells pointed both ends, connectival appendage starting c. halfway the cells as a cylindrical dark part, slightly longer than the cells, topped by c. 3–4 hyaline, very thin, 0.25 mm long setae. Ovary somewhat hour-glass shaped, glabrous; style very short, 0.5 mm.

Nut ellipsoid-ovoid, densely stellate-hairy, up to 12 × 15 mm, topped by a 3 mm long, pilose point. Sepals not developing into wings, almost equal, outer 3 thicker, inner slightly longer, ovate, acute, densely stellate-hairy. Pedicel 2 mm.

DISTRIBUTION: Wet, evergreen lowland forest in S.W. Ceylon from Colombo, Kalutara and Galle districts, up to the southern part of Sinharaja and in the Kanneliya forest near Hiniduma.

ECOLOGY: Can stand apparently unfavourable drier conditions than other Shoreas. If occuring in the such places (rocks) the boles become crooked with large buttresses, similar to those of *Balanocarpus brevipetiolaris* (Bonsai effect).

NOTE: The sepals do not develop into wings, similar to *Balanocarpus* fruit, but the flowers are entirely different from those of *Balanocarpus*. There are two trees in the Botanical Garden. Peradeniya with normal, cylindrical, boles and without buttresses. ASHTON saw apperantly only the crooked form on shallow (and hence dry soils) but wrongly generalized this for the species.

Moreover, the lateral nerves are not spreading, this is only true for the basal ones. The number of the lateral nerves as given by ASHTON (6–12) is certainly wrong, the low number of lateral nerves is typical (maximum 8 pairs), perhaps his decription was made after a mis-identified specimen.

Seedling leaves have an acumen, up to 2 cm. The vernacular names: Malmora (= walmora) is certainly wrong. The indumentum is different on the twigs and in the inflorescence, it was not properly described by ASHTON.

ASHTON's comment on BROUN's statement, that this was "a very common tree on the banks of the Bentota River" is not correct, the species can grow very well on aluvials, where I have found it. ASHTON had only seen trees on a poor site and made the wrong generalization (as he did for *Balanocarpus brevipetiolaris*).

Karawita Kande, pole tree, *de Silva* s.n. (PDA), pole tree, *Ashton 2132* (PDA); ster., *Waas 389* (PDA); Sinharaja forest, fl., Apr. 1855, *C.P. 3407* (PDA); southern Sinharaja, between Madegatte and Wallagalle, fl., March 1881, *C.P. 3407* (PDA); Kanneliya forest, ster., *Balasubramaniam s.n.* (PDA); Apr., fl., *Waas & Peeris* 549 (PDA); July, y.fr., *Kostermans 27739* (PDA); Jagirala forest, Udugama, both banks of Bentota R., fr., July 1893, *Broun s.n.* (PDA); Akuressa, alt. 100 m, ster., *Broun s.n.*, p.p. (PDA) (other part is *Shorea pallescens*); near Nellowe, fl., Apr. 1864, *C.P. 3407* (PDA); Botanic Garden, Peradeniya, Aug., fr., *de Silva 96* (PDA); Apr. fl., *de Silva 60* (PDA); *Livera s.n.* (PDA); June, fl., *Kostermans 28241, 28240* (AAU, G, L, PDA); May, fl., *Kostermans 27666* (AAU, G, L, PDA); June, y.fr., *de Silva 53* (PDA).

3. *Shorea oblongifolia* Thwaites — Fig. 18, 18a

Thwaites, Enum. Pl. Zeyl. 36. 1858; A.DC., Prodr. 16(2): 629. 1868; Dyer in Hooker f., Fl. Br. Ind. 1: 307. 1874; Trimen, Handb. Fl. Ceylon 1: 116. 1893 (exclud. note on galls, this refers to *Doona cordifolia*); Brandis, J. Linn. Soc. 31: 79. 1895; Lewis, Trees and flow. Pl. of W. & Sabaragamuwa Prov. 29. 1934; Worthington, Ceylon Trees 52. 1959; de Rosayro, Ceylon Forester, N.S. 4(3): 292. 1960; Ashton in Fosberg & Dassanayake (ed.), Revised Handb. Fl. Ceylon 1(2): 178. 1972; reprint 1: 386. 1980; Kostermans, Bot. Jahrb. Syst. 104(2): 189. f. 3. 1983; Nair & al., J. Econ. & Taxon. Bot. 3(3):

650. 1984. — Lectotypus propositum: *C.P. 3005*, sheet from Balangoda and Sinharaja forest, fl., Apr. 1855, fr., Sept. 1855 (PDA).

Tree, up to 35 m tall and 100 cm dbh. Buttresses small, thick, concave, up to 50 cm high and out. Bark dark brown, peeling off irregularly in large, thick pieces; live bark brown, fibrous. Twigs thickish, often angular, densely or sparsely covered by grey, microscopic stellate scales, older twigs smooth, glabrous. Terminal leaf bud globose, small, the ovate-suborbicular thick bud scales densely covered by tiny grey stellate scales. Stipules oblong, sub-acute, up to 3 × 6 mm, fugaceous. Leaves coriaceous to rigid-coriaceous, ovate-oblong, rarely elliptic, 4 × 8 – 5 (– 7.5) × 14 cm (sapling leaves up to 9 × 21 cm), glabrous (flush leaves underneath lepidote), shortly, rather obscurely acuminate (acumen with broad base, up to 1 cm long), base cordate (rarely rounded in leaves near the inflorescence); above glossy, smooth, midrib and lateral nerves impressed, below paler, usually smooth, midrib prominent, sometimes lepidote, lateral nerves 8 – 14 pairs, erect-patent, arcuate near the margin, slender, prominent, at base sometimes quintuplinerved, secondary nerves laxly scalariform, obscure. Petioles 1–1.5 mm long, densely, minutely lepidote, slender, apical part slightly swollen.

Panicles axillary and terminal, narrow, minutely densely grey stellate-lepidote with rather thick main peduncle and few, short, raceme-like branches, each bearing unilaterally 1–6 flowers. Flowers sessile or on thick, 1 mm long pedicels. Sepals broadly ovate, acutish, thick, densely grey stellate-hairy, 2–2.5 mm long. Petals cream, pink inside, lanceolate-oblong, 6 mm, outside densely white, appressed hairy (hairs coarse, straight), the margin excurved, not twisted, inside glabrous. Stamens c. 60– 80 with short, triangular filaments (upper part filiform), elliptic anther and a thick, cylindrical connectival appendage, shorter than the anther, topped by 3 hyaline, thin setae (the central one longer). Ovary and stylopodium densely pilose, style short, glabrous.

Fruit pedicels up to 2 mm long. Nut ovoid, ending in an acute point, up to 1.5 × 2 cm, silvery-white appressed hairy. The wings very variable in length, sometimes almost absent, the longer three broadly spathulate, obtuse, sparsely, minutely pilose, up to 2 × 6 cm, the smaller up to 1 × 4 cm.

DISTRIBUTION: Common, but scattered in all the wet parts of Ceylon, up to 700 m altitude, not restricted to any kind of soil or soil depth.

USE: Strong useful timber, particularly for joints and flooring planks or mine-planking, yields a clear resin, suitable for pale varnishes. Weight c. 60 lb/cub. ft. Wood brownish with a wavy grain (Lewis).

VERNACULAR NAMES: Pathuru, Yakahalu.

NOTE: De Candolle described the indumentum as velutinous, which it is certainly not. Trimen referred a branch with a charateristic hop-like gall to this, but this is *Doona cordifolia*. In their sapling stage *Doona cordifolia* and *Shorea oblongifolia* are very similar, but can be differentiated by their indumentum.

Colombo Distr., Labugama Kande, Febr., *sine coll.*, ster. (PDA); Puwakpitiya-Tamodera road, Apr., y.fr., *Jayawardena 9834* (PDA); Kitulgalle area, across Kelaniya R., steep slopes, 600 m, Apr., fl., *Kostermans 28384* (PDA) and *28383* (PDA); Eknaligoda, Sinharaja forest, fl., fr., Apr. 1858, fl., Sept. 1855, *C.P. 3005* (PDA); without locality, *C.P. 3005* (except the gall bearing branch); Mandeli Kande, Apr., fl., *J.M. de Silva* s.n. (PDA); Bambarabotuwa For. Reserve, above Pelmadulla, Ratnapura Distr., 400 m alt., May, fl., *Kostermans 28451* (PDA); Pasdun Korale, Moregalla, *sine coll.*, fl., June 1883 (PDA); Hiniduma, ster., *Trimen s.n.* (PDA); base of Hinidumkande (Haycock), ster., *Cramer 3088, Meyer 573* (PDA); Kanneliya forest near Hiniduma, ster., *Ashton 2098, 2043, Meyer 1059* (PDA); Ithandukita, near Nellowe, ster., *Ashton 2064* (PDA); Ingiriya near Padukka (cf. *Shorea pallescens* seedlings), *Livera s.n.* (PDA); Uduguma, Galle Distr., near Resthouse, ster., *Ashton 2040, Cramer 3082* (PDA); Sinharaja forest, Weddegalle entrances, ster., *Meyer 519* (PDA); Kahawatte near Ratnapura, ster., *Livera s.n.* (PDA); Beraliya forest near Elpitiya, fr., *sine collector* (PDA); Botanic Garden, Peradeniya, March, fl., *Kostermans 28213* (PDA); May, fl., P.W. *de Silva s.n.* (PDA); June, y.fr., J.M. *Silva 253* (PDA).

4. *Shorea pallescens* Ashton — Fig. 19

Ashton, Blumea 20: 360. 1972; in Fosberg & Dassanayake (ed.), Revised Handb. Fl. Ceylon 1(2): 179. 1977; reprint 1: 388. 1980; Kostermans, Bot. Jahrb. Syst. 104(2): 192. fig. 4. 1983. — Typus: *Worthington 4869* (K, L, US).

Shorea dealbata Alston ex de Rosayro, Ceylon Forester 1(2): 80. 1953.

Doona ovalifolia Auct. non Thwaites, Trimen, Handb. Fl. Ceylon 1: 123. 1893 (as to the note of Mr. Broun, from Ingiriya forest).

Large tree, up to 45 m tall and 120 cm dbh. Buttresses none or 3 m tall and out (Ashton). Bole straight, long, cylindrical; crown dense, hemispherical. Bark blackish brown, very deeply fissured, strips 5 cm wide, 1 cm thick, peeling in small pieces from the strips. Live bark pale brown, hard homogenous; sapwood straw-coloured, hard; heartwood dark brown (Ashton). Twigs slender, smooth, glossy red-brown, cylindrical, apical part with an amorphous grey layer. Leaf buds small, lanceolate, acute. Stipules not seen. Leaves ovate, 3 × 6 – 5 × 11 cm, sub-coriaceous, broadly, shortly acuminate (acumen c. 1 cm long), base rounded to broadly cuneate-rounded; above glossy green (fresh), smooth, midrib pale (fresh), prominulous, lateral nerves thin, faint, pale green (fresh); below covered with a thin, amorphous grey layer, midrib prominent, the 6–8 pairs of erect-patent lateral nerves thin, prominulous, arcuate near the margin, connected by faint, scalariform, horizontal secondary veins. Petiole slender, cylindrical, covered with a grey, amorphous mass, up to 2 cm long.

Panicles axillary, rather slender, rather few-flowered, densely, minutely stellate-hairy (hairs very thin), up to 15 cm long with long main peduncle and few, remote, up to 2 cm long, slender, racemiform branches, bearing 1–5 flowers unilaterarly (ventral). Pedicel thick, obconical, 1–2 mm. Sepals rather fleshy, concave, ovate, obtuse, equal in length (inner ones slightly narrower), 3–4 mm long, densely, minutely grey puberulous. Petals light yellow, falling separately, broadly sub-spathulate, c. 4 × 6 mm, pilose outside. Stamens c. 60, not connate, filaments 1 mm long, lower part flat, broad, upper part filiform; anthers transversally oblong, the pollen sacs

pointed at both ends, the connectival appendage starting from almost the base of the cells, very slender, hyaline setose. protuding 1–1.5 mm beyond the cells. Ovary sericeous, ellipsoid, 2.5 mm, merging into the 2.5 mm long, sericeous, tapered stylopodium, 0.5 mm long, glabrous style and punctiform stigma. Fruit more or less densely, minutely, finely puberulous. Large wings broadly spathulate, obtuse, 1.5 × 6 – 2.5 × 6 cm, basal convex part 1.5 cm. Small wings linear-oblong, 0.5 × 3 cm. Nut sub-globose, ovoid, 1 × 1.5 cm, ending in a sharp, conical, 10 mm long point.

DISTRIBUTION: Lowland, wet, evergreen forest in S.W. Ceylon from Colombo up to the Kanneliya forest, not extending further eastwards, below 500 m altitude.

NOTE: The cover of the under leaf surface and the tips of the twigs is amorphous and not scaly as stated by Ashton.

Domatia occur only in some leaves.

ASHTON says that the stipules are persistently buff-puberulent, but some lines further-on he says: stipules unknown.

Kegalle Distr., Tutengala, ster., *Ferguson s.n.* (PDA), sapling, leaves 8 × 14 cm, petioles 1 cm long, glabrous; Kalutara Distr., Yagirella Forest, Bentota R., ster., *Ashton 2088* (PDA); Ingiriya forest, Labugama, ster., *Broun s.n.* (PDA); Galle Distr., Kanneliya forest near Hiniduma 200 m altitude, ster., *Ashton 2047* (PDA); Madeleta Kande, ster., *Silva 254* (PDA); Botanic Garden, Peradeniya, Nov., fr., *P.W. de Silva 88* (PDA); ster., *Meyer 288* (PDA); June, fl., *Kostermans 28532* (AAU, G, L, PDA).

5. *Shorea stipularis* Thwaites — Fig. 20, 20a

Thwaites, Enum. Pl. Zeyl. 36. 1858 (with question mark; excluding *C.P. 3407*, in nota); J. Bot. 23: 205. 1875; A.DC., Prodr. 16(2): 631. 1868; Dyer in Hooker f., Fl. Brit. Ind. 1: 307. 1874; Trimen, Handb. Fl. Ceylon 1: 118. 1893 (exclud. var. *minor* Thwaites); Brandis, J. Linn. Soc. 31: 179. 1895 (nomen); Lewis, Trees and flow. Pl. W. & Sabaragamuwa Prov. 29. 1902; Veget. Prod. Ceylon 31. 1934; Alston in Trimen, l.c. 6 (Suppl.) 23. 1931; Worthington Ceylon Trees 53. 1959 (quoad nomen tantum); Ashton in Blumea 20: 361. 1972; in Fosberg & Dassanayake (ed.), Revised Handb. Fl. Ceylon 1(2): 179. 1977; reprint 1: 390. 1980 (exclud. Thwaites J. Bot.; description pro parte; exclud. *C.P. 3787, Ashton 2011, 2023, 2084*); Kostermans, Bot. Jahrb. Syst. 104(2): 194. f. 5. 1983. — Typus: Kuruwita Kande, Sinharaja, fr., Apr. 1855, *C.P. 3408* (PDA).

Tree, up to 45 m tall and 130 cm dbh., with long, straight, cylindrical bole and short, concave, thick buttresses. Crown usually dense, sub-globose. Bark dark brown, deeply fissured, flaking in large, thick, irregular pieces; live bark dark red brown, pale yellow-brown laminated, fibrous. Wood yellowish, rather soft, siliceous. Lower leaf surface of the red flush leaves, petiole and the apical parts of the twigs densely, very minutely stellate hairy (hairs very thin). Twigs stout, smooth with conspicuous amplexicaul stipule scars. Leaf bud elongate-ovoid, compressed, enclosed in the suboblong-ovate, obtuse or acutish, thick, longitudinally 12–16 veined, sessile, for a long time persistent, glabrescent stipules, 2–3 cm long, 1–2 cm wide. Leaves coriaceous to very

rigidly coriaceous, broadly elliptic to broadly oblong, 6 × 9 – 10 (–12) × 15 cm, obtuse or very obscurely, minutely broadly acuminate, base rounded or truncate; above glossy, midrib deeply impressed, lateral nerves slender, prominulous, below paler, midrib stout, prominent, lateral nerves 14–16 pairs, thin prominulous, erect-patent (basal ones more patent), shortly arcuate near the recurved margin, secondary nerves thin to very thin, dense, scalariform, perpendicular to the lateral nerves. Petiole slender to thick, 2–4 cm long, obscurely thickened near the apex.

Panicles in the axils of the upper leaves, 5–12 cm long, minutely, rather sparsely stellate hairy towards the apices, consisting of a rather slender main peduncle and few, remote, up to 10 cm long slender branches (sometimes no branches in the shorter panicles) with 1–5 flowers unilaterally, the branches with 2 basal bracts exactly like the stipules, but smaller, the apical bracts diminished to narrowly spathulate, up to 8 mm long at the base of the thick, 2 mm long pedicel. Sepals thickish, lanceolate, somewhat longitudinally concave, slightly obtuse, 8 mm long, outside minutely stellate-pilose. Petals white, oblong-ovate, contorted, 1 cm long, outside densely white appressed pilose (hairs coarse, straight), adhering at the base, falling as a rosette, 3 cm diam. Stamens 15, in 3 rows, as in *S. hulanidda*, c. 2 mm long, filament 1 mm long (lower part oblong, remainder filiform), anther 1 mm, narrowly oblong with 2–2.5 mm long not hyaline connectival appendage, acicular, starting just under the top of the anther cells. Ovary ovoid, puberulous, merging into a conical puberulous stylopodium (both together 2.5 mm long); style 1.5 mm, glabrous with reddish tip. Fruit pedicel thick, cylindrical, 2 mm long. Fruit globose to ovoid-globose, up to 2.5 cm in diam.,apically drawn out into a sharp point, the wings spathulate to linear-spathulate, the 3 longer ones 1 × 12 – 3 × 13 cm, with up to 13 longitudinal veins, obtuse, the smaller ones 1 × 7 – 1.5 × 9 cm, much narrower.

DISTRIBUTION: Wet, evergreen forest of the lowland of the S.W. Ceylon. Common but scattered. Up to 500 m altitude.

NOTE: For the characters, distinguishing it from *S. hulanidda*, see there. The indumentum (except the petals) is stellate, not lepidote and the inflorescences and flowers already when very young. In the Botanic Garden, Peradeniya, it came in full bloom in 1978, but did not produce a single fruit, for unknown reasons.

The nuts vary considerably in size. At germination the short hypocotyl lifts it above the ground.

ASHTON's key is in part confusing. On page 176 it says: "Style and stylopodium columnar, at least twice as long as ovary", which leads then to section *Anthoshorea* and section *Doonae*. On page 179 under *Anthoshorea* it says: "Ovary without distinct stylopodium". If the latter is correct, than the only Ceylonese species of *Anthoshorea* does not belong in that section.

USE: The bark of the tree is used as a substitute for that of *Vateria copallifera*, for preventing the alcohol in palm wine (toody) to turn into vinegar.

S.W. Ceylon, Karawita Kande, Sinharaja forest, April, fr., *C.P. 3400* (PDA); Sinharaja, Weddegalle entrance, fl., *Gunatilleke 312X*, buds,

Gunatilleke 40X (L); Aug. fr., *Gunatilleke 510X* (G, L); Sinharaja, Sept., ripe fr., *Kostermans 28728* (L); Titta Werakuwa Kotha, ster., *sine collector* (PDA); near Anningkande, Morowak Korale, *sine coll.*, ster. (PDA); Kanneliya forest, March. fl., *Kostermans 27721* (PDA); Botanic Garden, Peradeniya, March, y.fr., *Silva s.n.* (PDA); Nov., fl., *Ashton 2330* (PDA).

6. *Shorea hulanidda* Kosterm., — Fig. 21, 21a

Shorea stipularis var. *minor* Thwaites ex Trimen, J. Bot. 23: 205. 1875; Trimen, Handb. Fl. Ceylon 1: 118. 1893; Kostermans, Bot. Jahrb. Syst. 104(2): 196, f. 6. 1983. — Typus: *C.P. 3987* (PDA), Morowak Korale, below Captain Norley's Estate, fr. July 1868.

Shorea stipularis Auct. (non Thwaites) Worthington, Ceylon Trees 53. 1959; Ashton, Blumea 20: 361. 1972; in Fosberg & Dassanayake (ed.), Revised Handb. Fl. Ceylon 1(2): 179. 1977; reprint 1: 390. 1980, p.p. quoad cit. Thwaites ex Trimen, J. Bot. 23: 205. 1875, excluding part of the description, excluding *C.P. 3987* and *Ashton 2023, 2011, 2084.*

Typus: *C.P. 3987* (PDA).

Tree, up to 40 m tall, up to 120 cm dbh. Branchlets cylindrical, smooth, usually glabrous, rarely very minutely pilose. Terminal bud small. Stipules very large, sub-persistent, glabrous to laxly minutely stellate-scaly outside, ovate, acute, 1 × 2 cm, with c. 9 pairs of longitudinal veins. Leaves glabrous, coriaceous, subovate-elliptic to ovate-oblong, 3 × 5 – 5 × 12 – 4 × 9 – 2.5 × 6 – 6 × 13 cm, shortly acuminate (acumen twisted or not, 5–10 mm long with broad base, acute), base rounded; above smooth or microscopically reticulate-pitted, midrib impressed, lateral nerves faint; below midrib prominent, the 10–12 pairs of erect-patent, near the margin slightly arcuate lateral nerves thin, connected by obscure scalariform secondary nerves and in between a dense obscure reticulation. Petiole slender, 1.5 – 2 cm long, slit-like channeled above.

Panicles axillary, slender, glabrous, rather few-flowered, up to 10 cm long, with long, slender main peduncle and 1–2 thin, up to 5 cm long, raceme-like branches with 1–8 remote unilateral flowers. Pedicel slender, obconical, 2–4 mm long. Sepals equal in length, lanceolate, acute, glabrous, 4–5 mm long, the inner 3 narrower. Petals cream, lanceolate, acutish, 5 mm long, strongly twisted, outside rather sparsely puberulous (hairs simple, appressed). Filaments c. 15, 1 mm long, connate at the base and connate to the petals, flat, oval, the upper part filiform; anthers elliptic, 0.75–1 mm with hyaline, very thin 2 mm long setae. Ovary glabrous, 1 mm high, merging into the 2.5 mm long stylopodium and glabrous style.

The 3 large wings linear-oblong, up to 1.5 – 2 × 10 cm, obtuse, the 2 small ones 0.5 – 0.75 × 5 – 7 cm. Nut glabrous, 1 × 2 cm, sharply pointed.

DISTRIBUTION S.W. Ceylon, wet evergreen forest, up to 700 m altitude.

VERNACULAR NAMES: Nawa-dun or Hulanidda.

NOTE: The only available authentic material was *C.P. 3987*, I have not seen *C.P. 4024*. The material shows in some leaves the twisted acumen, the lower leaf surface is glabrous. Only detached immature fruit are present.

Ashton compared only the leaves of *S. stipularis* and our species, although he had flowering specimens at hand (*Peeris & Waas 544*, which he quotes as 554 and his own 2330 of *S. stipularis*).

The two species can be distinguished by their leaf shape and texture (very thick and obtuse in *S. stipularis*, less thick and acuminate in *S. hulanidda*), the stipules (large and with 12–16 veins in *S. stipularis*, much smaller and more acute with c. 9 pairs of veins in *S. hulanidda*), the twice as long sepals and petals of *S. stipularis*, the thicker pedicels, the pubescent sepals and the much more pubescent petals of *S. stipularis*.

In its sapling stage *S. stipularis* has leaves with a rounded apex with a very thin, abrupt acumen, those of *S. hulanidda* have a short, broad acumen. Sapling leaves may be up to 9 × 16 cm with an acumen of 1 cm.

The density of the indumentum in our species is not constant, but as a rule sparser than that of *S. stipularis*.

The vernacular name hulanidda means: hulan = wind, idda = Wrightia (Apocynaceae), of which of the flowers superficially resemble those of *S. hulanidda*.

Balangoda, Gawarhanana forest, 500 m altitude, ster., *Waas 1798* (PDA); Kanneliya forest near Hiniduma, 150 m altitude, March, fl., *Balasubramaniam 2454* (AAU, G, L, PDA); Apr., fl., *Waas & Peeris 544* (PDA); Sinharaja forest, N. of Nellowe, 500 m altitude, ster., *Ashton 2084* (PDA); ibid., Weddegalla entrance, 150 m altitude, pole tree, *Ashton 2023* (PDA); Morowak Korale, below Capt. Norley's Estate, July 1868, *C.P. 3927*, ster. (PDA); locality not indicated, fr., *C.P. 3987* (PDA); Bambarabotuwa Forest Reserve above Pelmadulla, 700 m altitude, ster., *Ashton 2011* (PDA).

Excluded species

Shorea affinis (Thwaites) Ashton = *Doona affinis* Thwaites
Shorea congestiflora (Thwaites) Ashton = *Doona congestiflora* Thw.
Shorea cordifolia (Thwaites) Ashton = *Doona nervosa* Thwaites
Shorea disticha (Thwaites) Ashton = *Doona oblonga* Thwaites
Shorea gardneri (Thwaites) Ashton = *Doona gardneri* Thwaites
Shorea megistophylla Ashton = *Doona macrophylla* Thwaites
Shorea ovalifolia (Thwaites) Ashton = *Doona ovalifolia* Thwaites
Shorea reticulata Thwaites ex Dyer in Hooker f., Fl. Br.Ind. 1: 307. 1874; Trimen, Handb. Fl. Ceylon 1: 117. 1893; Brandis, J. Linn. Soc. 31: 79. 1895; Ashton in Fosberg & Dassanayake (ed.) Revised Handb. Fl. Ceylon 1(2): 187. 1977; reprint 1: 404. 1980; Kostermans, Bot. Jahrb. Syst. 104(2): 199. 1983. — Typus: Morowak Korale, Sept. 1865, sterile branch and detached fr., C.P. 3884 (PDA); = not dipterocarpaceous.
Shorea trapezifolia (Thwaites) Ashton = *Doona trapezifolia* Thwaites
Shorea worthingtonii Ashton = *Doona venulosa* Thwaites

7. *Doona* Thw.

Hooker's J. Bot. Kew Gard. Misc. 4: 7. 1852; Dyer in Hooker f., Fl. Brit. Ind. 1: 211. 1874; Trimen, Handb. Fl. Ceylon 1: 118. 1893. — *Shorea* sect. *Doonae* (Thwaites) Ashton, Blumea 20(2): 300. 1973; in Fosberg & Dassanayake (eds.), Revised Handb. Fl. Ceylon 1(2): 180. 1977 (reprint 1:

391. 1980); Kostermans, Bot. Jahrb. Berlin 104: 425–454. 1984.
Type species: *Doona zeylanica* Thwaites.

Large or medium-sized trees, with or without buttresses. Bark dark brown, peeling off in large stiff plates (upcurled at their base) or in jigsaw-like, stiff, large pieces or in small, irregular pieces in those with a fissured or cracked bark. Crown either the *Shorea* type with long, bare ascendent, twisted branches, the ends densely short-branched with many leaves, the entire a convex, umbrella-shaped, open crown or (in the smaller species) the crown is equally dense without the long bare *Shorea* branches. Bark with clear resin, which often becomes opaque and white or yellowish. Most species produce little resin. Leaves entire, scattered, with rather obscure dense venation, in between the lateral nerves scalariform secondary ones. Stipules small, fugaceous, folded, clasping, the lateral buds. Terminal bud after a resting period often enlarging, becoming cone-like, covered with numerous, tiered bud-scales. Flowers in axillary few-flowered panicles, the branches racemes with the flowers all on one side. Inflorescences often succulent, white to pink or red, or both, rarely cream. The 3 outer sepals (or calyx lobes) thicker and larger, more concave than the 2 inner ones, growing out into 3 large and 2 short wings, which are strongly twisted, like the blades of a propeller, fleshy spathulate, veined, the smaller ones inconspicuous. Petals oblong to spathulate, longer than the sepals, hardly contort, outside often coarselly appressed pilose, falling as a whole in a rosette. Stamens 15 with very short, at base flattened, narrowly triangular or oblong, at apex filiform filament, anthers rather large (compared with those of *Shorea*) the acute thecae connected by dark red, thick, connective tissue, which between the tips of the thecae is produced in a conspicuous stout, club-shaped connectival appendage; valves equal. Ovary conical to ovoid with inconspicuous stylopodium; style pilose or glabrous, stigma minute. Nut one-seeded, acute, smooth, glossy. Cotyledons remaining in the seed after germination, lifted above the ground by the elongating, usually long hypocotyl (in *D. oblonga* a short hypocotyl). Cotyledons pale green, semi-circular, thickish, slightly wavy apically. First 2 leaves opposite.

DISTRIBUTION: Endemic to Sri Lanka.

ECOLOGY: All kinds of soil and independent on its depth, provided that they remain moist during the dry season.

NOTE: A well-defined genus and clearly different from *Shorea* by the following:

1. Indumentum of simple hairs (stellate-haired or lepidote in *Shorea*).
2. The white or red and white succulent inflorescences.
3. The very reduced 2 smaller wings.
4. The stiff, succulent, propeller-like twisted broad, large wings.
5. 15 stamens, but these are also found in *Shorea stipularis* and *S. hulanidda*.
6. Large anthers.
7. The large thick, club-like connectival appendage and the thick dark or dark red large connective tissue between the acute anther cells.
8. Short stylopodium, merging into the style.
9. Petals hardly twisted (falling as a rosette).

10. The sometimes enormously developed bud-scales, leaving a collar of packaged scars.
11. Chemical differences (Hegnauer in Ashton, Fl. Males. 9(2): 274. 1982).

The leaf galls found in some species are hop-like.

The difference between *Parashorea* and *Shorea* are less than those between *Doona* and *Shorea*

Key to the species

1. Midrib raised on the upper leaf surface 2
1. Midrib sunk on the upper leaf surface (rarely prominulous in a groove) 3

2. Leaves ovate-oblong, average 4.5 × 9 cm. Secondary intercostals visible on the lower leaf surface ..... 5. *D. nervosa*
2. Leaves ovate, average 3 × 6 cm. Secondary intercostals visible on the lower leaf surface 7. *D. ovalifolia*

3. Apical part of twigs and inflorescences puberulous 4
3. All parts (except petals) glabrous 5

4. Leaves coriaceous, ovate-oblong to elliptic, average 4 × 7 cm with 7–12 pairs of lateral nerves. Intercostals dense, scalariform ..... 2. *D. congestiflora*
4. Leaves chartaceous to thinly coriaceous, lanceolate to lanceolate-rhomboid, average 3 × 7 cm with 12–16 pairs of lateral nerves. No scalariform intercostals; venation reticulate ..... 8. *D. trapezifolia*

5. Twigs pendulous. Basal part of the leaf margin up to ½ – ⅓ the lamina length strongly recurved ..... 10. *D. zeylanica*
5. Twigs horizontal or erect. Basal part of the leaf margin not recurved or only recurved at the very base 6

6. Leaf buds enveloped in very large bud-scales, which leave a conspicuous collar or closely packed horizontal scars ..... 6. *D. oblonga*
6. Leaf buds enveloped by very tiny bud-scales, leaving small, obscure scars, or no bud-scales 7

7. Leaves large, 5 × 10 × 12–27 cm ..... 4. *D. macrophylla*
7. Leaves much smaller 8

8. The base of the leaf margin strongly recurved. Mountain species 3. *D. gardneri*
8. The base of the leaf margin hardly or not recurved. Lowland species 9

9. Lenticels on the twigs elongate. Budscales very small. Leaves usually ovate, caudate-acuminate, with very conspicuous secondary (intercostals) and tertiary scalariform veins. Pedicel 4–6 mm. Petals covered with very minute hairs ..... 9. *D. venulosa*
9. Lenticels of the twigs round. No budscales. Leaves usually lanceolate, acuminate. Secondary and tertiary veins invisible. Petale covered with adpressed, long, coarse hairs..... 1. *D. affinis*

1. *Doona affinis* Thwaites — Fig. 22, 22a

Enum. Pl. Zeyl.: 35. 1858 (not *D. affinis* p. 402. 1864, quoad *D. venulosa*); A.DC., Prodr. 16(2): 627. 1868; Dyer in Hooker f., Fl. Brit. Ind. 1: 311. 1874 (quoad nomen tantum, descript. exclud.); Trimen, Handb. Fl. Ceylon 1: 120. 1893; Brandis, J. Linn. Soc. 31: 52. 1895; Kostermans, Bot. Jahrb. Berlin

104(4): 426, fig. 1. 1984. — *Shorea affinis* (Thwaites). Ashton, Blumea *20(2)*: 361. 1973; in Fosberg & Dassanayake (eds.), Revised Handb. Fl. Ceylon 1(2): 181. 1977, (reprint 1: 392. 1980).— Lectotypus: Sinharaja, April 1885, fr., *C.P. 3409* (PDA)

Tree, up to 35 m tall and 70 cm dbh., usually smaller, glabrous in all its parts, except the petals. Buttresses in old trees only, thin, concave, low. Bark light brown, cracked longitudinally and flaking; live bark pale brown. Sapwood pinkish; heartwood redbrown (Meyer). Terminal bud very small. Twigs slender with numerous, tiny, round lenticels. Stipules linear-lanceolate, acute, 4 mm, fugaceous. Leaves sub-coriaceous to coriaceous, lanceolate, more rarely ovate-lanceolate or oblong, 15 × 4 – 2.5 × 7 – 3 × 6 – 3(–4) × 9 cm, tapered into an obtuse, conspicuous, slender, up to 1.5 cm long acumen, base obtuse, rarely sub-cuneate; above midrib thin, impressed, or slightly prominulous in a depression, lateral nerves and the very dense nervation (visible under the lens) slightly prominulous, the intercostals not differentiated; below midrib slender, prominent, lateral nerves 8–10 pairs, very thin, obscure, erect-patent, arcuate, with shorter intermediate ones, reticulation very obscure, intercostals not developed; margin at the base revolute. Petiole very slender, c. 1 cm long, above slit-like channeled. Flush leaves dark red.

Panicles axillary of the upper leaves, slender, few-flowered, white to pale cream, succulent, up to 3 cm long, with few, slender branches up to 1 cm long. Pedicel long, 4–6 mm, articulate with the as thin branchlet. Outer 3 sepals oblong, obtuse, not very stiff, c. 4 mm long, inner ones thinner, ovate, acutish, 2.5 mm long. Petals white or cream, oblong to spathulate, 5 mm long, apical part outside densely white, coarsely appressed pilose. Anthers 1.25 mm long, the club-shaped connective appendage overtopping the anther cells for 0.5 mm. Ovary glabrous; style long.

Nut elongate-ovoid, up to 7 × 10 mm, acute, the 3 long wings spathulate, 3 × 0.5 – 1 cm, obtuse, short wings 5 mm, acutish; pedicel 8 mm long.

DISTRIBUTION: Wet, evergreen lowland forest in S.W. Ceylon, up to 400 (–800) m altitude.

NOTE: Dyer described this species after *C.P. 3712* from Lihinigalle, March 1861, which Thwaites erroneously enumerates under *Doona affinis* in the Addendum of his book (p. 402) in 1864. This is *Doona venulosa*. Trimen commented on this specimen and thought that it was either *D. venulosa* or *D. oblonga*.

The tree rarely reaches large dimensions.

The base of the leaf is revolute and was wrongly described by Ashton; in this character it corresponds both with *D. zeylanica* and *D. gardneri*. Distinctive are the undistinguishable intercostal scalariform veins.

Roadside near Madampe, Kalawana Road, 400 m alt., March, fr., *Kostermans 28440* (PDA); Nellowe-Pelawatta Road, 130 m alt., pole tree, *Ashton 2072* (PDA); Sinharaja forest, S.W. Ceylon, Weddegalle entrance, 200 m alt., March, fl., *Ashton 2072* (PDA); Sinhagalle, alt. 400 m, Febr., fl., *Waas 1945* (PDA); Sinharaja, April 1855, fr., *C.P. 3409* (PDA); Kottawa Arboretum near Galle, 50 m alt., ster., *Ashton 2096* (PDA); Udugama, anno

1890, fr., *Walker s.n.* (PDA); Kanneliya forest near Hiniduma, ster., *Meyer 541 (541a*= seedling, *541b* = sapling), *987, 988, 1010, 1040* (PDA); April, fl., *Ashton 2088, 2089, 2091* (PDA); *Cramer 3072* (PDA); June, fl., *Kostermans 24988*; June, fr., *Kostermans 24985* (PDA); Hinidumkande (Haycock); Karawita Kande, Ratnapura Distr., 400 m alt., sapling, *Ashton 2262* (PDA); Balangoda, ster., *Lewis s.n.* (PDA); Bambarabotuwa Reserve, ster., *Meyer 433, 435* (PDA); Kiribatgalle near Pelmadulla, 800 m alt., ster., *Ashton 2120* (PDA).

2. *Doona congestiflora* Thwaites — Fig. 23

Enum. Pl. Zeyl.: 35. 1858; Atlas t.XI A.DC., Prodr. 16(2): 627. 1868; Dyer in Hooker f., Fl. Brit. Ind. 1: 312. 1874; Trimen, Handb. Fl. Ceylon 1: 122. 1893; Brandis, J. Linn. Soc. 31: 52. 1895 (nomen); Lewis, Cat. Trees Ceylon 32. 1902; Veget. Prod. Ceylon 35. 1935; Alston in Trimen, l.c. (Suppl.) 6: 24. 1931; Worthington, Ceylon Trees 54. 1959; de Rosayro, Ceylon Forester, N.S. 4(3): 293. 1960; Kostermans, Bot. Jahrb. Berlin 104: 427, fig. 2. 1984. — *Shorea congestiflora* (Thwaites). Ashton, Blumea 20(2): 362. 1972; in Fosberg & Dassanayake (eds.), Revised Handb. Fl. Ceylon 1(2): 181. 1977, (reprint 1: 393. 1980); Nair & al., J. Econ. & Taxon. Bot. 3(3): 649. 1984. — Typus: *C.P. 3411* (PDA), Hinidoon (Hiniduma), Apr. 1855, fl. and Hellessee, Pasdun Korale, fl. Apr. 1855.

Tree, up to 35 m tall and 40 cm dbh. with low, concave buttresses. Bark redbrown, closely fissured; live bark redbrown to meaty red, fibrous. Sapwood ochre. Resin plenty, yellowish, turning black. Branchlets thickish, of the flush densely, minutely puberulous, later glabrous with numerous, tiny lenticels. Stipules lanceolate, acute (one side straight, the other curved, as they are folded), 7–12 mm long, outside minutely puberulous. Terminal bud small, flat with few, densely, minutely puberulous bud-scales. Leaves glabrous, coriaceous, ovate-oblong to elliptic, 2.5 × 6 – 8 × 7 – 3.5 × 8 – 5 × 13 cm, conspicuously acuminate (acumen broad or slender, 5–15 mm long), base rounded to broadly cuneate; above densely, minutely veined, midrib broadly shallowly impressed or prominulous is a depression, lateral nerves faint, below as a rule less pronounced-veined, midrib prominent, the 7–12 pairs of the lateral nerves thin, towards the margin arcuate, erect-patent, connected by scalariform secondary nerves and very faint (above clearer) scalariform tertiary ones. Petiole slender, initially puberulous, 10–12 mm, slit-like channeled above.

Panicle pink, sub-terminal and axillary, up to 5 cm long, stiff, few-flowered; main peduncle long and the few, short branches rather thick, densely, minutely puberulous, the raceme-like branches with 1–4 flowers. Pedicel pink, thickish, 2–3 mm. Outer sepals thickish, stiff, oblong, obtuse, 4 mm long; inner ones ovate, pointed 1.25 – 2 mm long. Petals broadly sub-spathulate, 5–6 mm long, outside glabrous or slightly pilose (hairs thin). Stamens and ovary as in the genus.

Fruit wings c. 4 cm long, 5–10 mm wide, the nut 1 cm, ovoid, strongly pointed, glossy (resinous), the shorter wings ovate, acute, 1.5 cm long, acuminate; pedicel slightly obconical.

DISTRIBUTION: Southwestern part of Ceylon, wet lowland, Kalutara, Galle, Matara, Ratnapura District, formerly common.

VERNACULAR NAMES: Tiniya or Tinniya (Sinhalese).

ECOLOGY: Wet, evergreen forest on all kinds of soil, provided enough water holding during the dry season, up to 800 m altitude.

NOTE: I have not seen any cordate leaves, except those of saplings. The seedlings have glabrous branches and may in this way be differentiated from the quite similar ones of *D. trapezifolia*; like in *D. trapezifolia* these seedlings have very short petioles; the longer, narrower leaves have a subcordate base.

No other fruit, than those of the type specimen were available, they are immature.

The timber is excellent for tea boxes and plywood, but unsuitable for construction purposes. Weight 30–36 lb/cubic foot, highly resinous, soft, reddish.

The species is close to *D. trapezifolia* (Ashton compared it with *Shorea worthingtonii*), but differs in leaf shape and leaf texture, fewer lateral nerves, a thicker inflorescence, glabrous flowers and its dark red live bark. The bark is easly stripped off and is hence used for walls of temporary forest dwellings.

Hiniduma area, Hinidumkande (Haycock), S.W. Ceylon, ster., *Meyer 580* and *Cramer 3091* (PDA); Hiniduma Pattu, Apr. 1855, fl., *C.P. 3411* (PDA); Kanneliya forest, ster., *Meyer 1035* (PDA) (quoted as *4035* by Ashton); Ratnapura Distr., Kalawana Road, mile 15, ster., *Ashton 2024* (PDA), *Meyer 453* (PDA); Gilimale forest, 150 m alt., Dec., fl., *Bernardi 16053* (G, PDA); Carney Road, ster., *Meyer 430* + sapling (PDA); beginning of Udukarawita Road, 150 m alt., sapling, *Ashton 2026*; ster., *Ashton 2022* (PDA); Nellowe-Pelawatte road, 120 m alt., ster., *Ashton 2075* (PDA); above Beverley Estate, Deniyaya, 800 m alt., sapling, *Kostermans s.n.* (PDA); Hellessee, Pasdun Korale, Apr. 1855, fl., *C.P. 3411* (PDA).

3. *Doona gardneri* Thwaites — Fig. 24

Enum. Pl. Zeyl.: 35. 1858; A.DC., Prodr. 16(2): 628. 1868; Beddome, Fl. Sylv. S. India t. 98. 1869; Dyer in Hooker f., Fl. Brit. Ind. 1: 312. 1874; Trimen, Handb. Fl. Ceylon 1: 121. 1893; Alston in id. 6 (Suppl.) 24. 1931; Brandis, J. Linn. Soc. 31: 52. 1895 (nomen); Lewis, Cat. Trees. Ceylon 30. 1902; Veget. Prod. Ceylon 32. 1934; Worthington, Ceylon trees 55. 1959; C. Woon & Hsuan Keng, Gard. Bull. Singapore 32: 10, fig. 6 (a,b,c,f,g), fig. 7 (a-c), 50. 1979; Kostermans, Bot. Jahrb. Berlin 104(4): 432, fig. 3. 1984; Nair & al., J. Econ. & Taxon. Bot. 3(3): 649. 1984. —*Shorea gardneri* (Thwaites) Ashton, Blumea 20(2): 362. 1973; in Fosberg & Dassanayake (eds.), Revised Handb. Fl. Ceylon 1(2): 183. 1977, (reprint 1: 397. 1980); Popham, Bull. Pacific trop. Gard. 13(4): 77–81. 1983. — Lectotypus propositum: *C.P. 1919, Gardner s.n.*, Rapanda, July 1853, fl., fr. (PDA).

Tree, up to 40 m tall and 100 cm dbh., usually, however, not more than 20–25 m tall. Buttresses only in old trees, concave, thick, rounded, up to 1 m high and 1 m out. Bark dark brown, thin, in older trees cracked and flaky; live bark thick, 3–15 m, fibrous, yellow to orange brown. Stipules completely folded around the bud, lanceolate, acute, glabrous (rarely with a few microscopic hairs), 4 × 10 mm, fugaceous. Twigs slender, dark

redbrown, minutely sparinglly lenticellate. Leaves subcoriaceous to coriaceous, ovate, more rarely oblong ovate, 2.5 × 4 – 3 × 6 – 4 – 5 × 9 cm, tapered, acuminate (acumen 5–10 mm), base very strongly revolute, obtuse to sub-cordate (when unfolded), margins slightly revolute; above smooth or (in thinner leaves) densely reticulate, midrib slender, deeply impressed; below midrib prominent, the 10–12 pairs of erect-patent, thin lateral nerves prominent, near the margin for a short distance arcuately ascendent, connected by dense, scalariform intercostals, usually not differentiated from the dense reticulation in between, occasionally sub-equal intermediate lateral nerves. Petiole long and slender, 2–3 cm, narrowly channeled above.

Panicles axillary of the upper leaves, up to 7 cm long, lax, glabrous, many flowered with rather slender main white peduncle and few, up to 3 cm long raceme-like branches. Flower buds ovoid. Pedicel thickish, obconical, 2 mm. Outer 3 calyx lobes stiff, thick, concave, ovoid, obtuse, 3.5 mm long; inner ones 2–2.5 mm, ovate, acutish, thinner, stiff. Petals white, inside pink, spathulate to oblong, obtuse, 6 mm, outside densely, white, coarsely appressed pilose. Anthers oblong, 1 mm long; connectival appendage club-shaped, 0.5 mm. Style pilose.

The larger wings linear-oblong, 1 × 4 cm, obtuse, or spathulate; the shorter ones 5 mm long. Nut ovoid, acute, up to 8 × 14 mm with 3 mm long stylopodium. Pedicel slender, up to 5 mm long.

DISTRIBUTION: Formerly the most common mountain *Doona* in all wet mountain areas (not in the Knuckles), gregarious, from 800–1700 m altitude, growing on ridges and slopes, on deep and on shallow soils.

VERNACULAR NAMES: Tamil name: Konge Koongili, a collective name for many species. Sinhalese: Ratu (=red) Doon (not Rata Doon as Ashton spells it, which means foreign Doon).

USE: Wood redbrown; freshly cut the heartwood is pale pink. Wood very durable, close-grained and excellent for beams and other heavy weight-supporting work. Weight c. 60 lb/cubic foot (Lewis). Yields a clear resin, which becomes yellowish after long exposure.

NOTE: Very close to *D. affinis* and when young indistinguishable from it. *D. gardneri* has longer petioles and usually a shorter, broader leaf; the outer sepals are more robust, larger and broader; the secondary nerves are visible.

Above Le Vallon Estate, Galaha, 1500 m alt., ster., *Kostermans 28509* (L); Dolosbage, Horogalle, Apr., fr., *Cramer 4636* (PDA); Ginigathena — Maskeliya Road, 1400 m alt., ster., *Ashton 200* (PDA); Dickoya, Dec. 1889, ster., *Alexander s.n.* (PDA); above Moray Estate, Maskeliya, 1200–1500 m alt., gregarious, Dec., fl., *Kostermans 27238* (PDA); June, fr., *Kostermans 24928* (PDA); Balangoda, 1300 and 1500 m alt., ster., *Meyer 441, 469, 962* (PDA); Rakwana, Kurulagalla, 950 m alt., sapling, *Ashton 219, 2130* (PDA); Aigberth Estate, Bulutota Pass, 1000 m alt., fr., *Worthington 1643* (PDA); Aberfoyle Estate, Bulutota Pass, 1000 m alt., gregarious, ster., *Kostermans s.n.* (L); Ratnapura Distr., Maratenne, 1000 m alt., Aug., fr., *Waas 1788* (PDA); *C.P. 1919* three sheets (PDA); as sine local., fr.; b. Hewahetter, Apr. 1852. fl.; c. Rapanda, *Gardner s.n.*, July 1853, fl., fr.

4. *Doona macrophylla* Thwaites — Fig. 25, 25a, 25b

Enum. Pl. Zeyl.: 402. 1864; A.DC., Prodr. 16(2): 627. 1868; Dyer in Hooker f., Fl. Brit. Ind. 1: 312. 1874; Trimen, Handb. Fl. Ceylon 1: 124. 1893; Lewis, Cat. Trees Ceylon 32. 1902; Veget. Prod. Ceylon 37. 1934; Alston in Trimen, l.c. 6 (Suppl.): 24. 1931; Worthington, Ceylon Trees 56. 1959. — *Shorea megistophylla* Ashton, Blumea 20(2): 362. 1972; in Fosberg & Dassanayake (eds.), Revised Handb. Fl. Ceylon 1(2): 184. 1977, (reprint 1: 398. 1980); C. Woon & Hsuan Keng, Gard. Bull. Singapore 32: 10, fig. 6 (c,d,h,i), fig. 7 d. 1979; Kostermans, Bot. Jahrb. Berlin 104(4): 434, fig. 4. 1984; Nair & al., J. Econ. & Taxon. Bot. 3(3): 649. 1984. — Typus: Habarala, Hinidoon Pattu (Hiniduma), March, Apr. 1861, fl., *C.P. 3713* (PDA, 2 sheets, excluding the detached fruit from Kukul Korale, July 1868).

Tree, up to 30 m tall and 70 cm dbh. with 1–3.5 m high, concave, thin buttresses, out 1 m. Bark dark brown, flaky in large, 2–3 mm thick plates, upturned at their base, sub-persistent; the underlying bark very smooth, light brown. Leaf bud small, usually globose with usually densely, minutely tomentellous bud-scales. Leaves stiffly coriaceous, elliptic to oblong to subovate-oblong. Live bark pale brown. Resin pale yellow. Leaves 5 × 10 – 5 × 13 – 11 × 23 – 8 – 12 × 27 cm, shortly, broadly, rather obscurely acuminate, base rounded or truncate to sub-cordate; above glossy, either smooth or showing an intricate pattern of veins, midrib impressed or the centre slightly prominulous in a groove; below paler, midrib strongly prominent, lateral nerves slender, prominent, 13–16 pairs, erect-patent (lower ones more patent), disappearing arcuately towards the slightly recurved margins connected by scalariform intercostals and dense scalariform to tertiary veins, sometimes venation rather obscure. Petiole thickish, 1–3 cm, narrowly channeled above. Stipules narrowly elliptic, acute, up to 5 × 15 mm, early caducous. Flush leaves dark purple.

Panicles axillary, white and pink or red and white, succulent, 3–32 cm long with stout main peduncle and few, up to 4 cm long raceme-like branches, each bearing 1–6 succulent white flowers. Pedicel thick, obconical, 5–8 mm long. Outer sepals oblong, obtuse, 5–7 mm, glabrous; inner ones triangular or broadly ovate, flat, thinner, 3–4 mm long. Petals succulent, broadly elliptic, 6–8 mm long, outside densely sericeous (white, coarse hairs), except where they overlap. Filaments flat, thin, triangular, 1 mm; anthers 3 mm, the pollen sacs acute, laterally dehiscent, the connective in between the sacks dark red, thick, protruding club-like for 1–1.5 mm beyond the pollen sacs. Ovary glabrous, minute, ovoid, base truncate; style as long or slightly longer than the stamens.

Fruit wings oblong to spathulate, obtuse, up to 4–5 cm long, up to 1.5 cm wide apically, narrowed to 5 mm or more at the base, the thickened part 1.5 cm long; the inner two wings narrowly ovate, acute, up to 1.5 cm long. Nut narrowly ovoid to ovoid, very acute, smooth, up to 1 × 2.5 cm.

DISTRIBUTION: Wet, evergreen lowland forest in S.W. Ceylon, up to 800 m altitude.

USE: Wood pale brown, hard close-grained, durable, suitable for roofing (Lewis).

NOTE: The connective appendage starts c. 0.5 mm below the tips of the pollen sacs. De Candolle calls the young twigs and the lower leaf surface of the flush leaves pilose; this could not be confirmed. Often the small, concave, orbicular bud-scales are densely minutely tomentellous.

The flush leaves are a pretty purple. The fruits are eaten. The trees have abundant, pale yellow resin, even in the leaves there is much resin. The racemes are glabrous, not lepidote (De Candolle).

Seedling: The pale green cotyledons remain in the fruit, which is lifted a few cm above the ground by the hypocotyl; the first leaves are somewhat purplish underneath, this becomes green later.

S.W. Ceylon, Moropitiya, E. of Matugama, Aug., fr., *Meyer 1083* (PDA); Gilimale forest near Ratnapura,a lt. 100 m, ster., *Ashton 2016, 2017; Meyer 417, 425, 490* (PDA); Kanneliya forest near Hiniduma, ster., *Broun s.n.,; Cramer 3073; Meyer 1073* (PDA); March, after anthesis, *Kostermans 27444* (A, G, K, L, P, PDA); June, fr., *Kostermans 24983* (id.); Habarala, Hiniduma Pattu, fl. March & Apr. 1861, *C.P. 3713* (PDA, holo); Hewesse, Mandagala Mukalana (Mukalana, Sinhalese=forest), March 1887, after anthesis, coll.? (PDA); above Beverly Estate, Deniaya, 800 m alt., May, young fr., *Kostermans 28449* (AAU, G, L, PDA); Botanic Garden, Peradeniya, March, fl., Kostermans 28192 (AAU, G, L, PDA); Apr., fl., *Kostermans 27516* (id.), May, fr. *Kostermans 28476* (id.); *Ashton 620* (PDA), *de Silva 85* (PDA); *Ashton 2107* (PDA); May, after anthesis, *Kostermans 27669* (AAU, G, L, PDA); June, fr., *de Silva 74* (PDA); Sept., ripe fruit, *Kostermans 27669*a (AAU, G, L, PDA).

One sheet, a sterile branch plus detached fruit is erroneously numbered *C.P. 3408* (PDA), it bears a note, that it has been also distributed under *C.P. 3987*; it is not mentioned by Thwaites in his Enumeratio.

5. *Doona nervosa* Thwaites — Fig. 26

Enum. Pl. Zeyl.: 35. 1858; A.DC., Prodr. 16(2): 627. 1868; Dyer in Hooker f., Fl. Brit. Ind. 1: 311. 1874; Trimen, Handb. Fl. Ceylon 1: 121. 1893 (exclud. *Walker s.n.,* quoad *D. affinis*); Alston in id. 6 (Suppl.) 24. 1931; Brandis, J. Linn. Soc. 31: 52. 1895 (nomen); Lewis, Cat. Trees Ceylon 31. 1902; Veget. Prod. Ceylon 33. 1934; Worthington, Ceylon trees 37. 1959; Ashton, Blumea 20(2): 182. 1971, (reprint 1: 394. 1980), as a syn. of *Shorea cordifolia* (exclud. *D. cordifolia* and its type collection, which is real *D. cordifolia*); Kostermans, Bot. Jahrb. Berlin 104(4): 417, fig. 5. 1984; Nair & al., J. Econ. & Taxon. Bot. 3(3): 649. 1984. — Typus: Ratnapura Distr., Eknaligoda, Apr. 1855 and March 1861, *C.P. 3410* (PDA).

Doona cordifolia Thwaites, l.c. 35. 1858; A.DC., l.c. 628; Dyer in Hooker f., l.c. 312; Trimen, Handb. Fl. Ceylon 1: 144. 1893; Alston in id. 6. l.c.; Lewis, Veget. Prod. Ceylon 35. 1934. — *Shorea cordifolia* (Thwaites) Ashton, Blumea, l.c. 262; in Fosberg & Dassanayake, l.c. 182 and 394. — Typus: Pasdun Korale and Ambagamuwa at no great elevation. "Betralaya", ster. *C.P. 3340* (PDA).

Tree, up to 20 m tall and 70 cm dbh. Buttresses hardly indicated. Bark light brown, exfoliating in very large, 3 mm thick plates, underneath smooth, hammered light brown. Crown dense, hemispherical (not Dipterocarp type). Flush purplish red. Twigs slender, smooth, glossy with tiny elongate

lenticels. Buds small, covered by many tired bud-scales, the apical ones up to 2 mm long, oblong, the lower ones ovate-rotundate, acutish, minutely, finely pilose (hairs straight), leaving a rather inconspicuous collar of packed scars. Leaves chartaceous, ovate-oblong, rarely ovate, 3 × 7 – 4 × 6 – 5 × 10 – 5 × 15 cm, tapered to a rather slender, 1–2 cm long, obtuse acumen, base rounded, rarely sub-cordate; above midrib thin, prominent, the thin lateral nerves and scalariform intercostals faint, prominulous; below midrib slender, prominent, the slender, 6–11 pairs of lateral nerves prominulous, erect-patent, arcuate; near the margin fairly ascendent, intercostals dense, scalariform. Petiole slender, channeled (folded) above.

Panicles 1–3 in the axils of the upper leaves, initially covered by tiered bud-scales, up to 5 cm long, not branched or with very few, short branches, each bearing a few flowers; main peduncle white, slender (dried), succulent (fresh). Pedicels 4–5 mm. Outer calyx lobes oblong, obtuse, concave, 4–5 mm long; inner 3 flat, ovate-triangular, thinner, acute, 2.5 mm. Petals waxy white, succulent, not twisted, spathulate, obtuse, 5–6 mm long, densely, very finely sericeous outside. Anthers oblong, 1.5 mm long. Ovary small, glabrous, ovoid; style 2 mm long with punctiform stigma.

Infructescences initially white waxy, succulent (when dried very thin), branchlets up to 2 cm long. Fruit pedicels 5 mm long, obconical. Large wings (initially pinkish white, succulent, rather fleshy), sharply twisted like a propeller, broadly spathulate, obtuse, up to 1.5 × 4 cm, the 3 short ones ovate, acute, 3–5 mm long; all wings with gibbose base, surrounding the glabrous, narrowly ovoid, sharply acute, smooth nut, up to 3 × 15 cm.

DISTRIBUTION: Ashton was correct in fusing *Doona nervosa* and *D. cordifolia*. When he referred the species to *Shorea* the correct name became *S. cordifolia*, as the combination *S. venulosa* was preoccupied. Now, referred back to *Doona*, the name *D. nervosa* can be maintained.

Doona cordifolia is a badly known species; the type specimen is a gall-bearing (a hop-gall) sterile shoot of a sapling, *C.P. 3340* (erroneously quoted by Ashton as *C.P. 3410*), the holotype bearing sheet in Peradeniya (PDA) has 4 parts (not 3 as pretended by Ashton), two are gall-bearing twigs (leaves not cordate), the third branch has smaller leaves (also no cordate base) and the fourth is a single leaf (which might be *D. venulosa*). This sheet is marked in pencil: Linaya, Pasdun Korala, Jan. 1855 and a piece of paper is glued on with the legend: Saffragam, May 1869.

This scrappy material is explained by Thwaites's remark, that he had only sterile material and that the seeds which he had received were all sown and not-retained for the herbarium and hence he could not describe them.

It is not completely correct, when Ashton says, that Trimen confused it with *Shorea dyeri*. Trimen says explicitely, that *Shorea dyeri* had not been again collected and the identification of the sterile material of *Shorea dyeri* specimen from Lunugalle is *Doona cordifolia* with a question mark.

Thwaites did not mention the galls, which might imply that he had other material.

A. De Candolle enumerated *Doona cordifolia* under the heading: species fere incognita.

Dyer added to Thwaites's description, that there are 10 pairs of lateral nerves and calls the petioles rugose; however, in the Peradeniya material they

are smooth, and as De Candolle did not mention the galls, he too must have seen other material.

Trimen did not present further clarification, he had neither seen fruit or flower (except young fruit in 1887, these are *D. nervosa*), nervertheless he says that the tree flowers in February.

Alston quotes the Tamil name Koongili (Koongilian resin in Tamil language) from Lewis; however the latter quotes this for *D. congestiflora*.

Lewis writes 1902; " Is this the same as Pulun Yakahala in Udugama? Trimen says the roasted seeds are eaten, which is perhaps not true", and in his Veget. Products: "I am not satisfied as to this species in as I have found two or more, that do not occur in Trimen's Flora, that might be referred to under this name".

The type sheet of *D. nervosa* (PDA) consists of 2 branches, one sterile, which conforms with the small-leaved branch of the sheet of *D. cordifolia*, the other has fruit and should be accepted as part of the holotype.

The puzzle of the cordate leaves of *D. cordifolia* was solved by my collection from Kitulgalle, where part of the leaves are indeed cordate, but the name is certainly a misnomer as cordate leaves are an exception.

The holotype of *D. nervosa* is marked: Eknaligodde (= Eknaligoda) near Ratnapura, Apr. 1855 and March 1861; the branchlet has young fruit, but there is also mounted a detached, almost ripe fruit. There are 2 more sheets in Peradeniya, one marked: Hewesse, March 1861 and June 1868, which has young fruit and one with branches with almost ripe fruit, these are unmarked, but perhaps part of the holotype from Eknaligoda.

USE: The timber is hard, closely grained, rather heavy. The resin is pale yellow, clear, but only little is produced. The sapling have often galls, shaped like hop fruit.

Across Kelaniya R. near Kitulgalle, ridge forest, 600 m alt., fr., *Kostermans 28380* (PDA); Kalutara Distr., Badureliya, close to Maguru Ganga, June, fr., *Cramer 4177* (PDA); along road near stream near Moropitiya, y.fr., *Balasubramaniam 872* (L); June, fl., *Kostermans 24975* (PDA); Delwitiya Dola, Moropitiya, low, Febr., after anthesis, *Waas 2087* (PDA); Gilimale forest Reserve near Ratnapura, 100 m alt., ster., *Meyer 401, 418; Ashton 2018, 2020* (PDA); July, fr. *Meyer 828* (PDA); Kutapitiya forest, Ratnapura, 800 m alt., May, y.fr., *Waas 1590* (PDA), Ithandukita near Nellowe, Febr., fl., *Jayasuriya 1523* (PDA); ster., *Ashton 2063* (PDA); Hinidumkande (Haycock), ster., *Meyer 567* (PDA); June, fr., *Kostermans 27680* (PDA); ster., *Meyer 972, Ashton 2045* (PDA); Hewesse, Lihinigalle forest, March 1887, *sine coll.*, y.fr. (PDA); Hewesse, March 1861 and June 1868, *C.P. 3410* (PDA); Kuruwita Korala, Eknaligoda, alt. 100 m, ster., *Ashton 2009* (PDA); ibid., Apr. 1855 and March 1861, fl. and fr., *C.P. 3410* (PDA); ibid., fl. March 1861, fr. June 1861 *C.P. 3410* (PDA); Thawalama, banks of Gin Ganga, ster., galls, *Waas 1327* (PDA); Rakwana-Kalawana Road, ster., *Tirvangadum 340* (PDA); East Sinharaja forest, above Beverley Tea Estate, 1000 m alt., March, fl., *Kostermans 28148* (PDA); Kiribat-Linaya, Jan. 1854, ster., galls, *C.P. 3340* (PDA); Botanic Garden, Peradeniya, April, y.fr., *Stone 11309* (PDA); Apr. fr., fl., *Ashton 2106* (PDA); May, fr., *Kostermans 27670 & A* (PDA); May, fl., *Kostermans 24588* (PDA); May, fr., *Ashton 619, 814* (PDA), June, fr., *de Silva 56* (PDA).

6. *Doona oblonga* Thwaites — Fig. 27, 27a

J. Bot. 23: 206. 1885; Trimen, Handb. Fl. Ceylon 1: 125. 1893 (excluding the doubtfully included *C.P. 3712*); Brandis, J. Linn. Soc. 31: 53. 1895 (nomen); Alston in Trimen, l.c. 6 (Suppl.): 24. 1931; Ashton, Blumea 20(2): 362. 1973; in Fosberg & Dassanayake (eds.), Revised Handb. Fl. Ceylon 1(2): 183. 1977, (reprint 1: 396. 1980) (as a synon. of *Shorea disticha*); Kostermans, Bot. Jahrb. Berlin 104(4): 440. fig. 6. 1984. — Typus: *C.P. 2986* (PDA).

Vateria disticha Thwaites, Enum., l.c. 404. 1864; A.DC., Prodr. 16(2): 620. 1868; Dyer in Hooker f., Fl. Brit. Ind. 1: 303. 1874; Trimen, l.c. 127. — *Vatica disticha* (Thwaites) A.DC., l.c. 620. 1868; Dyer in Hooker f., l.c. 303 (with question mark). — *Sunaptea? disticha* (Thwaites) Trimen, Catal. Fl. Zeyl. 9. 1885; Handb., l.c. 127; ibid. (Hooker f.) 5: 383. 1900. — *Doona? disticha* (Thwaites) Pierre, Fl. Forest Cochinch., fasc. 15: t. 237. 1890; Heim, Bull. Soc. Bot. France 39(1): 153. 1892; Rech. Dipterocarp. 72. 1892. — *Stemonoporus distichus* (Thwaites) Ashton, Blumea 20(2): 362. 1973; in Fosberg & Dassanayake, ll.cc. — Typus: Kegalle, Lenegal Kande, Nov. 1861, ster., *C.P. 3707* (PDA, 2 sheets).

Tree, up to 40 m tall and 50 cm dbh., with small numerous spreading buttresses or buttresses absent. Bole cylindrical. Bark dark brown, longitudinaly cracked; strips 3 cm wide, 3 mm thick, irregularly scaly in large plates, upturned at their base. Live bark hard, fibrous, ochraceous, near the cambium yellowish. Resin clear, drying opaque white. Twigs rather thick, densely, minutely softly tomentellous. Terminal bud small in resting stage, becoming cone-like with many tiered large scales when developing, the lower scales sub-orbicular, hardly pilose, the apical ones lanceolate with a dense layer of long apressed hairs, like the flush pale green, up to 5 × 12 mm long, acutish; when dropped leaving a conspicuous collar of closely packed, horizontal thin, narrow ridge-like scars. Leaves rigidly coriaceous, soon glabrous, ovate-oblong to lanceolate-oblong to ovate sub-elliptic, 3 × 9 – 4 × 14 – 6 × 12 – 7.5 × 7 cm, conspicuously, slenderly acuminate (acumen up to 1.5 cm); base rounded, more rarely sub-cordate, margins revolute; both surfaces with a dense nervation, but often obscure or only visible on the upper or on the lower surface; above midrib broad, slightly impressed, below midrib prominent, the 8–12 pairs of lateral nerves slender, prominent, erect-patent, disappearing arcuately towards the margin, connected by more or less visible numerous scalariform intercostals perpendicular to them and these by numerous scalariform tertiary veins. Petiole 1–1.5 cm, puberulous, slit-like channeled above.

Panicles axillary, glabrous, fleshy, wine red, up to 7 cm long with long main peduncle and very few branches, of which the lower ones may be up to 5 cm long, the ultimate fleshy racemes bearing 1–7 fleshy, white flowers. Pedicels thick, obconical, 5 mm. Outer sepals fleshy, ovate, obtuse, 5–6 mm long, inner ones thinner, ovate 3–4 mm long, margin fimbriate. Petals white, fleshy, spathulate, densely sericeous outside (except where they overlap) slightly longer than the outer sepals. Stamens and ovary as in the genus.

Fruit wings 3–3.5 cm long, spathulate, up to 12 mm wide, obtuse, constricted at the base, the part covering the nut thick, 1 cm long. Inner 2 sepals 10–12 mm long, obtuse. Nut ellipsoid-ovoid, smooth, 2 cm long, strongly-pointed. At germination the hypocotyl remains short, contrarily to that of other *Doona* species.

DISTRIBUTION: S.W. Ceylon, Ratnapura and Hiniduma areas.

ECOLOGY: Wet, evergreen lowland forest, up to 900 m altitude.

NOTE: Ashton (1980: 396) writes: "bark surface configuration not recorded", but quotes several Meyer specimens, which have a description of the bark. The foliar buds are wrongly described by Ashton, they are not stipulate, but covered with bud-scales, at the time of expanding the leaf bud is very large, conical, with tiered bud-scales, the first ones rather glabrous and orbicular, the upper ones becoming long-hairy and very long. The stipules are different. The bud-scales leave conspicuous scars, visible even on old branches as a collar of close, parallel, horizontal thin ridges, similar with those found in *Persea* (Lauraceae, perulate buds).

Trimen correctly called the scales bracts, which he believed to envelop the developing inflorescence.

C.P. 3712 (Trimen, l.c. 120) was accidentally referred by Thwaites to *Doona affinis* (Enum. 202) and Dyer's description was made after that number. Trimen thought that *C.P. 3712* should be either *D. venulosa* or *D. oblonga* and quotes it with a question mark under *D. oblonga*.

The plants have large galls (c. 3 cm diam.) like globose hopfruit, with numerous lanceolate, 3 cm long difformed leaves, similar to those of *D. nervosa*.

S.W. Ceylon, Hinidduma Pattu, Kanneliya forest, alt. 150 m, ster., *Cramer 3078; Meyer 552, 1004* (quoted by Ashton as *604*), *1015, 1038* (PDA); March, buds, *Balasubramaniam 2456* (AAU, G, L, PDA); June, fr., Kostermans 24994 (PDA); Hinidumkande (Haycock), ster., galls, Meyer 570, Cramer 3086 (PDA); Godakande near Hiniduma, 200 m alt., ster., brown galls, Kostermans 25676 (PDA); ibid., May, fl., fr., Kostermans 27615 (AAU, G, L, PDA); Ratnapura Distr., Gilimale forest, Carney Road, ster., Meyer 424 (PDA); Agar's Land forest, 900 m alt., May, buds, Waas 1611 (PDA); Udugama, ster., Lewis s.n. (PDA); Kegalla, Lenegal Kande, Nov. 1861, ster., large perulate buds, C.P. 3707 (PDA, 2 sheets); locality not indicated, y.fr., C.P. 3986 (K,PDA).

7. *Doona ovalifolia* Thwaites — Fig. 28, 28a, 28b

Enum. Pl. Zeyl. 402. 1864; A.DC., Prodr. 16(2): 626. 1868; Dyer in Hooker f., Fl. Brit. Ind. 1: 313. 1874; Trimen, Handb. Fl. Ceylon 1: 129. 1893 (exclud. note on Broun's specimen from Ingiriya forest, which is *Shorea pallescens*); Brandis, J. Linn. Soc. 31: 53. 1895 (nomen); Lewis, Cat. Trees Ceylon 22. 1902; Veget. Prod. Ceylon 36. 1934; Alston in Trimen, l.c. 6 (Suppl.) 124. 1931; Worthington, Ceylon Trees 59. 1959. — *Shorea ovalifolia* (Thwaites) Ashton, Blumea 20(2): 303. 1973; in Fosberg & Dassanayake (eds.), Revised Handb, Fl. Ceylon 1(2): 184. 1977, (reprint 1: 400. 1980), pro parte (excluding part of the description, excluding ecological notes, vernacular names, excluding specimen *Ashton 2066*); Kostermans, Bot. Jahrb. Berlin 104(4): 443, fig. 7. 1984; Nair & al., J. Econ. & Taxon. Bot. 3(3): 649. 1984. — Lectotypus propositum: *C.P. 3711* (PDA), the sheet marked Ratnapura fl. March 1861.

Shorea cordifolia Auct. (non Ashton), Ashton in Dassanayake, ll.cc. 182 and 395 quoad *Meyer 556.*

Tree 16–18 m tall, dbh. 90 cm; bole short, superficially narrowly fluted up to 4 m, no buttresses. Bark dark brown, peeling of patchily in large, hard, 2 mm thick plates, upturned at their base, underneath a very smooth, light brown bark. Branchlets slender, glabrous. Terminal bud small with few bud scales. Stipules oblong (folded), 20 × 3 mm, acute, one side straight, outer one curved, pink (fresh), very early caducous. Leaves ovate to oblong-ovate, 2 × 4 – 3.5 × 7 – 4 × 8 cm, caudate-acuminate (acumen slender, obtuse 1–2.5 cm long), base rounded, above smooth or almost so, midrib thin, prominulous; below paler, midrib slender, prominent, lateral nerves 6–8 pairs (a few more in the acumen), thin, prominulous, erect-patent, towards the margin arcuate and somewhat ascendent, intercostals scalariform, prominulous, near midrib arcuately horizontal, towards the margin perpendicular to the lateral nerves; the intercostals connected by obscure, numerous scalariform tertiary veins, in between the lateral nerves a few short intermediate ones or those lacking. Petiole slender, 7–10 m, deeply channeled above.

Panicles very slender, white (fresh), few-flowered, 2–7 cm long, axillary, glabrous, main peduncle thin, long, branchlets few, racemiform, up to 1 cm long, bearing 1–2 flowers. Pedicels white, slender, 5–8 mm long. Flower buds globose. Sepals white, the outer 3 concave, oblong, thickish, glabrous, 5–6 mm long, the inner 2 thinner, flat, 3–3.5 mm long. Petals white, connected at the base in a short neck, the exposed parts densely grey sericeous (hairs coarse), spathulate, 4–5 mm long. Stamens 15, glabrous, filaments flattened, narrowly triangular, 0.5–0.75 mm long, base connate; anthers slender, oblong, acute, 2–2.5 mm long; pollen sacs acute, white, laterally dehiscent; the dark thick connective starting from the anther base, protruding beyond the pollen sacs as a thick, dark, cylindrical stalk ending in a club, both together c. 1 mm long. Ovary glabrous, bell-shaped, 1– 1.5 mm high; style glabrous, 5–6 mm long, apex wavy, stigma punctiform.

Fruit small, the 3 wings broadly spathulate, up to 2.5 cm long, apically 1 cm wide, obtuse, veined, narrowed to 3–5 mm width near the base; the 2 smaller wings narrowly ovate, acute, up to 1 cm long. Nut up to 1 cm long, narrowly ovoid, glabrous, smooth, gradually merging into the c. 8 mm long style.

Leaf galls ovoid, glabrous, up to 2 cm long; covered with numerous, oblong-linear reduced leaves, 1–2 cm long, apically with spreading up to 5 cm long, linear, acute reduced leaves.

DISTRIBUTION: Only known from the Hewesse area (Nellowe). Never recollected after 1928 (Alston); one tree in the Botanic Garden, Peradeniya.

ECOLOGY: not known.

VERNACULAR NAMES: Piniberiliya.

NOTE: Ashton based the description of *Shorea ovalifolia* partly on his sterile collection (*Ashton 2066*), which, however, represents *Hopea modesta* and hence the discrepancies with Trimen's description. It is also inexplicable why the leaves are called broadly cuneate and subcordate, there is not a single sub-cordate leaf in the collection cited. The description and size of the tree is

apparently that of the sole tree in the Botanic Garden but that is only 16–18 m tall and not 35 m, as Ashton says.

The midrib is definitely not impressed, but prominent in all authentic material; it is impressed in *Ashton 2066*, but this is *Hopea modesta*.

Ashton's vernacular name for this species is wrong. The timber is hard and close-grained and there is abundant resin (Lewis).

The leaf galls are similar to those of *D. nervosa*. The specimen, collected by Broun at Ingiriya near Labugama, commented upon by Trimen represents *Shorea pallescens*.

After germination the red or green cotyledons remain for the greater part in the fruit, which is lifted above the ground by the elongating hypocotyle. The first leaves are opposite.

S.W. Ceylon, Ratnapura, March 1861, buds, *C.P. 3711* (PDA); Hewesse, June 1856, fr., *C.P. 3711* (PDA); without locality, fr. & galls, *C.P. 3711* (PDA); Lihinigalle, Hewesse, sine coll., March 1887, buds (PDA); N.W. of Hiniduma, May, fr., *Alston 2347* (PDA); Botanic Garden, Peradeniya, May, fl., *Kostermans 27665* (AAU, G, L, PDA); June, fr., *Kostermans 28529* (AAU, G, L, PDA); Apr., buds, *Ashton 2101* (PDA); sine collector (PDA); Apr., fl., *de Silva 59* (PDA); May, fl., *de Silva s.n.* (PDA); June, fr., *de Silva 72* (PDA); ster., *Meyer 821* (PDA); ? Kanneliya forest near Hiniduma, ster., *Meyer 556* (PDA).

8. *Doona trapezifolia* Thwaites — Fig. 29

Enum. Pl. Zeyl. 35. 1858; A.DC., Prodr. 16(2): 627. 1868; Dyer in Hooker f., Fl. Brit. Ind. 1: 311. 1874; Trimen, Handb. Fl. Ceylon 1: 121. 1893; Brandis, J. Linn. Soc. 31: 52. 1895 (nomen); Lewis, Cat. Trees Ceylon 31. 1902; Veget. Prod. Ceylon 34. 1934; Alston in Trimen, Handb. Fl. Ceylon 6 (Suppl.): 24. 1931; Worthington, Ceylon Trees 60. 1959; Kostermans, Bot. Jahrb. Berlin 104(4): 446. fig. 8. 1984; Nair & al., J. Econ. & Taxon. Bot. 3(3): 649. 1984. — *Shorea trapezifolia* (Thwaites) Ashton, Blumea 20(2): 363. 1973; in Fosberg & Dassanayake (eds.), Revised Handb, Fl. Ceylon 1(2): 185. 1977, (reprint 1: 401. 1980).— Lectotypus propositum: *C.P. 3341*, Ambagamuwa, Dec. 1854, young fls. and two fruit packages (PDA).

Tree, sometimes up to 45 m tall and 150 cm dbh., with large stout, concave buttresses, up to 3 m high and out. Bark dark brown, in older trees deeply fissured, peeling in rectangular, 3 mm thick strips; live bark orange brown, fibrous, up to 10 mm thick. Sapwood pale yellowish, very soft; wood pale yellowish. Twigs slender, very minutely puberulous. Leaf buds small with few bud-scales, older twigs with numerous tiny, round lenticels. Stipules folded, lanceolate (one side straight, other curved), acute, sub-coriaceous, c. 3 × 15 mm, early caducous. Leaves chartaceous to thinly coriaceous, glabrous, lanceolate to lanceolate-rhomboid, 1.5 × 4 – 2 × 5 – 3 × 7 – 4 × 9 cm, distinctly acuminate (acumen with broad base, upt ot 1 cm long), base rounded to broadly cuneate, above conspicuously, very densely, minutely veined, midrib impressed; lower surface with prominent midrib, the 12–16 pairs of lateral nerves very thin, arcuate towards the margin (intermediate only few, short), connected by sub-scalariform nerves (irregular, wavy, branched) and these by a dense reticulation, similar to that of the upper surface, but usually much more obscure. Petiole slender, c. 1 cm, slit-like channeled above.

Panicles axillary, few-flowered, up to 6 cm long with fleshy, slightly puberulous main peduncle and few, up to 3 cm long, obtuse, glabrous, slender raceme-like branches, each with 1–5 flowers. Pedicels slender, 3–4 mm, slightly thickened apically. Outer sepals oblong-ovate, obtuse, 4–5 mm long, fleshy inner ones ovate, acutish, 3 mm. Petals yellow, spathulate, 4–5 mm long, only the margins and the tips densely, minutely appressed pilose outside. Anthers 1.5 mm long, connectival appendage club-shaped, protruding 1–1.5 mm; filaments flat, narrowly triangular, 1–1.5 mm long.

Fruit pedicel thick, obconical, 5–7 mm, distinct from the branchlets. Wings sub-spathulate-oblong, 3–4 cm long, 5–12 mm wide, narrowed at the base, the part over the nut 1 cm long; the short wings ovate, acute, 5 mm. Nut ovoid, up to 15 mm long, 10 mm diam., sharply pointed.

DISTRIBUTION: S.W. Ceylon, from Nawalapitiya and Kitulgalle, through-out Sinharaja forest, from almost sea level to 1200 m alt.

ECOLOGY: On all kinds of soils which retain enough moisture during the dry season in the wet zone.

VERNACULAR NAMES: Yakahalu

USE: Wood hard , close-grained suited for house building, beams and plywood. Weight c. 60 lb/cubic foot. Yields a pale resin (Lewis). Fruit eaten in the Southern Province, they are dried, pounded, and made into flour. It is said that only once in 7 years there are enough fruit (after a long, dry spell).

NOTE: The seedling leaves have a cordate base and a very short (up to 5 mm) petiole; the branches are pilse with erect hairs, which are much longer than those of the mature plant.

Thwaites called it: Tuccahalaloo gass (gass = tree), a corruption of Yaccahaloo, the common vernacular name.

Between Nawalapitiya and Watawela, 800 m alt., fl. Sept. 1891. *Alexander s.n.* (PDA); Rassagalle, Agar's land, 750 m alt., March, y.fl., *Ashton 2021* (PDA); ibid. Tumbagoda, alt. 1000 m, June, fl., *Kostermans 24465* (A, BO, G, K, L, P, PDA); Ratnapura Distr., Rakwana, Kurulagala, 900 m alt., sapling, *Ashton 2128* (PDA); ibid., 1200 m alt., June, fl., *Waas 1736* (PDA); Apr., fl., *Ashton 2127* (PDA); Bulutota Pass, Aigberth Estate, 1000 m alt., *Ashton 2032* (PDA); Pelmadulla, Kuttapitiya Estate, May, fl., *Norris s.n.* (PDA); Handepan Ella Plains, 400 m alt., July, fr., *Waas 1399* (PDA); Sinharaja forest, Weddegala entrance, 200 m alt., sapling and July, fr., *Meyer 521* (PDA); Oct., fr., *Kostermans 27848* (AAU, G, L, PDA); Sept. fr., *Kostermans 28726* (L); June, fl., *Kostermans 28764* (PDA); Apr. 1855, buds, *C.P. 3341* (PDA); Marathagalla, 1200 m alt., June fl., *Waas 1755* (PDA); Ambagamuwa, Dec. 1854, fr. (in package) and April 1861, fl., *C.P. 3341* (K, PDA); Central Prov., May 1866, seedling (PDA).

9. *Doona venulosa* Thwaites — Fig. 30

Enum. Pl. Zeyl. 402. 1864; A.DC., Prodr. 16(2): 628. 1868; Dyer in Hooker f., Fl. Brit. Ind. 1: 313. 1874; Trimen, Handb. Fl. Ceylon 1: 123. 1893; Alston in id. 6 (Suppl.) 24. 1931; Brandis, J. Linn. Soc. 31: 53. 1895 (nomen); Livera, Ann. Roy. Bot. Gard. (Peradeniya) 9: 92. 1924; Lewis, Veget. Prod. Ceylon

36. 1934; Worthington, Ceylon Trees 61. 1959; Kostermans, Bot. Jahrb. Berlin 104(4): 448. fig. 9. 1984.— *Shorea worthingtonii* Ashton, Blumea 20(2): 363. 1973; in Fosberg & Dassanayake (eds.), Revised Handb, Fl. Ceylon 1(2): 186. 1977, (reprint 1: 402. 1980). — Typus: South of the Island, Sept. 1860, *C.P. 3675* (PDA).

Tree, up to 30 m tall (usually average 15 m) and 70 cm dbh., glabrous in all its parts, except the petals. Buttresses small, rounded, concave. Bark brown, smooth, peeling off occasionally in large, 2 mm thick plates, which are upturned at their base; live bark yellowish to pale brown. Sapwood yellowish brown. Twigs slender, stiff, with tiny elongate lenticels. Resin glossy, turning yellow. Terminal leaf bud small, broadly conical, surrounded by numerous tiny, stiff, 2 mm long, concave, oblong bud-scales, which leave a collar of dense horizontal scars. Stipules not seen. Leaves rigidly coriaceous, ovate to oblong-ovate, rarely lanceolate, 2 × 6 – 2 × 7 – 4.5 × 9 cm, abruptly caudate-acuminate (acumen up to 1 cm long, slender, obtuse), base rounded, rarely acutish; above midrib impressed, lateral nerves, intercostals and tertiary scalariform veins very conspicuous, evenly strong (rarely surface smooth and lateral nerves faint impressed); below midrib prominent, the 6–9 pairs of lateral nerves faint, thin, erect-patent (the lower pair sometimes more ascendent or, in the case of a subcordate base, the lower ones quintuplinerved), secondary scalariform veins lax, faint. Petiole thin, c. 1 cm, slit-like channeled above.

Panicles axillary of the upper leaves, few-flowered, white, succulent (the upper face of the branches often pink) up to 6 cm long with few, up to 4 cm long branches, each with up to 4 flowers. Pedicels 4 mm long, apically thickened. Sepals white, stiff, concave, oblong, obtuse, 5 mm, inner 3 ones much thinner, broadly ovate, 3 mm long. Petals white, concave, stiff, elliptic, obtuse, 5 mm long, the apical part and parts not covered by the adjacent petals with a very minute indumentum of white hairs. Anthers elongate, 1.5 mm long, connectival appendage 0.5 mm exserted. Ovary small, glabrous, style 2 mm, stigma inconspicuous.

Nut ovoid, up to 1.5 × 2.5 cm, sharply pointed, the large wings spathulate, 1.5 × 3–4 cm, obtuse, the short wings ovate, acute, 5 mm. Pedicel 6 mm. Wings first white, later reddish, succulent.

DISTRIBUTION: Wet, low evergreen forest in S.W. Ceylon, up to 400 m altitude.

VERNACULAR NAME: Beriliya.

NOTE: The original description was based on sterile material. In 1931 Alston described the flowers from a tree of the Botanic Garden, Peradeniya.

Leaves of saplings may be up to 4 × 8 – 5 × 13 cm with 2 cm long acumen.

The fruit of the Berilya is the most appreciated and the largest one of the Doonas of the wet lowland forests of S.W. Ceylon. About every 7 years (the number is actually not fixed), after a severe dry period, the fruit setting is good and the villagers go into the forest to collect guni-sacks full of this fruit (sold in Hiniduma in 1978 for 1.5 Rupee, in Galle for 10 Rupee a pound). They are boiled and eaten with rice, and taste like potatoes.

The seedling has a short hypocotyl (2 cm), greenish cotyledons and the first two opposite leaves have only 4–5 pairs of lateral nerves.

Across Kelaniya R. near Kitulgalle, steep slopes, 200 m alt., Apr., fl. *Kostermans 28379* (PDA); Sinharaja forest, Weddegalle entrance, June, y.fr., *Kostermans 28541* (PDA); Hinidumkande (Haycock) near Hiniduma, 400 m alt., June, fr., *Kostermans 27552* (PDA); Aug., ripe fruit and sapling, *Kostermans 28622* (L); Kanneliya forest, 200 m alt., ster., *Cramer 3081, Ashton 2086, Meyer 969* (PDA); Ratnapura Distr., Gilimale forest reserve, Carney Road, 100–200 m alt., ster., *Meyer 422, 427, 428, Ashton 2015* (PDA); Pelmadulla, Kutapitiya Estate, fl., *Norris s.n.* (PDA); Kottawa Arboretum near Galle, 50 m alt., ster., *Ashton 2095* (PDA); Botanic Garden, Peradeniya, 450 m alt., March, fl., *Kostermans 28186* (PDA); April, fl., *Kostermans 27217* (PDA); Apr., buds, *Ashton 2108* (PDA); May, fr., *Kostermans 28472* (PDA); Oct., y.fr., *de Silva 77* (PDA); low country, Sept. 1860, ster., *C.P. 3675* (PDA); Lihinigalla, March 1861, fl., *C.P. 3712* (PDA).

10. *Doona zeylanica* Thwaites — Fig. 31

Hooker's J. Bot. Kew Gard. Misc. 3: t. 12. 1851; 4: 7. 1852; Enum. Pl. Zeyl.: 34. 1858; A.DC., Prodr. 16(2): 626. 1868; Beddome, Fl. Sylv. S. India t. 97. 1871; Dyer in Hooker f., Fl. Brit. Ind. 1: 311. 1874; Trimen, Handb. Fl. Ceylon 1: 119. 1893; Brandis, J. Linn. Soc. 31: 51–52. 1895 (nomen); Heim, Rech. Dipterocarp. t. 11. 1892; Lewis, Cat. Trees Ceylon 30. 1902; Veget. Prod. Ceylon 31. 1934; Alston in Trimen, l.c. 6 (Suppl.) 23. 1931; Worthington, Ceylon Trees 62. 1959; Kostermans, Bot. Jahrb. Berlin 104(4): 451, fig. 10. 1984; Nair & al., J. Econ. & Taxon. Bot. 3(3): 649. 1984. — *Shorea zeylanica* (Thwaites) Ashton, Blumea 20(2): 363. 1973; in Fosberg & Dassanayake (eds.), Revised Handb. Fl. Ceylon 1(2): 186. 1977, (reprint 1: 463. 1980). — Lectotypus propositum: *C.P. 2423*, Deltota, fl., May 1851 (PDA); syntypus: *C.P. 2423*, Deltota, fr. Aug. 1851 (PDA).

Tree up to 45 m tall and 100 cm dbh., usually smaller, glabrous in all its parts, except the petals. Crown as in typical *Doona*. Branches pendulous. Flush cream. Buttresses up to 60 cm high, steep, rounded. Bark deeply fissured, dark rusty brown, flaky in small pieces, live bark yellowish brown, sapwood pale ochre, heartwood yellowish brown. Terminal buds minute. Stipules, lanceolate, 0.5 × 3 cm, fugaceous. Resin clear, becoming opaque grey. Twigs slender with minute, round lenticels. Leaves thinly coriaceous, lanceolate or ovate-lanceolate, 2 × 5 – 1.5 – 2 × 7 – 3 × 9 cm, tapered into a slender, long, obtuse, up to 1–2 cm long acumen, base acute, the basal third of the lamina strongly revolute; above midrib thin, impressed (or basal part somewhat prominulous in a groove), very densely, prominulously reticulate (under the lens), lateral nerves and intercostals hardly or not differentiated, often bullate in the lateral nerve axils, below midrib prominent, lateral nerves c. 12 pairs, erect-patent, prominulous with many shorter intermediates and dense reticulation, intercostals widely spaced, often with elongate, pilose domatia in the axils of the lateral nerves. Petiole thin, up to 1.5 cm long, slit-like channeled above. Panicles axillary, whitish, rather few-flowered, up to 6 cm long with thin peduncle and few, thin, up to 1 cm long raceme-like branches, each with 1– 4 flowers. Pedicel thin, 7–10 mm, slightly thickened apically. Sepals white, oblong, concave, obtuse, 3–3.5 mm long, inner 2

ovate, acutish, thinner, 2.5 mm long. Petals white (rarely pinkish), oblong, obtuse, 5–6 mm long, slightly, very minutely appressed pilose in their upper part outside. Filaments 0.5 mm long. Anthers 1.5 mm long, connectival appendage club-shaped, protruding 0.5 mm. Ovary glabrous, sharply demarcated from the 5 mm long style with minute capitellate stigma.

Nut narrowly ovoid, glabrous, acute, 7 × 10 mm. The 3 large wings narrowly spathulate, obtuse, 2.5 cm long, the short wings 5 mm, ovate, acutish. Pedicel slender, 8 mm long.

DISTRIBUTION: Lowland, wet evergreen forest in S.W. Ceylon, formerly much more widely distributed, in many places exterminated, up to 1000 m altitude.

VERNACULAR NAME: Doon (Sinhalese), Koongili (Tamil).

NOTE: Excellent timber for building purposes, beams, etc. and cannot be surpassed for roof shingles, which are easly split from it. In old trees; the heartwood is soft, it is brownish straw-coloured with close grain; weight 68–70 lb/cubic foot.

Adam's Peak Jungle, Carney, 600 m alt., ster., *Meyer 511* (PDA); Sinharaja forest, Weddegalle entrance, 200 m alt., Aug., fr., *Gunatilleke 380X* (PDA); E. Sinharaja, above Beverley Tea Estate, c. 1000 m alt., March, fl., *Kostermans 28125* (PDA); Rakwana, Kurulgalla, Apr., buds, *Ashton 2131* (PDA); sapling, *Ashton 2132* (PDA); Balangoda, Ella Uda, 600 m alt., July, fl., y.fr., *Cramer 4721* (PDA); Deltota, fl. May 1851, fr., Aug. 1851, *C.P. 2423* (PDA); Botanic Garden, Peradeniya, 450 m alt., Apr., fl., *Asthon 2102* (PDA); March, fl., *Kostermans 27428* (PDA); *sine collector*, March 1889, fl. (PDA).

8. *Balanocarpus* Beddome

Forest Manual, Addendum 236. 1873; Fl. Sylvat., tab. 330 & 331. 1874; Trimen, Handb. Fl. Ceylon 1: 130. 1893; Brandis, J. Linn. Soc. 31: 100. 1895; Alston in Trimen, Handb. Fl. Ceylon 6 (Suppl.) 26. 1931; Gamble, Fl. Madras 84. 1935; Bole, Kew Bull. 1951: 145–146. 1951; van Slooten, Reinwardtia 3(3): 315–346. 1956; Ashton, Blumea 20(2): 359. 1972 (as a synon. of *Hopea*); in Fl. Malesiana, Ser. I, 9(2): 273, 276, 388, 415, 560. 1982 (as subsect. *Hopea*, one representing the monotypical *Neobalanocarpus* heimii (King) Ashton); Maury-Lechon, Dipterocarpacées. Du fruit á la Plantule. Thesis 1 A: 56 (fruit of *B. heimii*), 91 (embryo of the same), 222 (included in *Hopea*); II: fig. D (14–16; id., 73 (fruit), 84 (seedling of id.), fig. 285 (epidermis of id.), fig. 324 (stomata of id.), fig. 335 (epidermis of id.), fig. 525 (trichomes of id.), fig. 582 (id.); Kostermans, Bull. Museum nation. Hist. Nat. Paris, 4e Sér., Sect. *B. Adansonia* no. 2: 173– 177. 1981. — Type species: *Balanocarpus erosa* Beddome.

Trees. Stipules minute, early caducous. Flowers in axillary panicles, the rachis bearing distichous racemes. Calyx of 5 imbricate sepals, somewhat united at the base. Petals 5, somewhat connate at the base, falling as a rosette; corolla cup-shaped or urceolate, the apical part of the lobes obliquely

enrolled. Stamens 15 (or irregular from 9–15) in two whorls (outer whorl of 10), very small; filaments triangular, flat; anthers small, sub-globose, deeply divided into two parts, dehiscent laterally; connectival appendage filiform, as long as the anther. Ovary elongate ovate, merging into a subconical style; stigma punctilate. Fruit elongate ovate, glossy, longitudinally striped or ridged, strongly apiculate. Sepals somewhat enlarged under the fruit, not wing-like, clasping the fruit, the 3 outer ones with thickened saccate base, strongly imbricate; the 2 inner ones thinner. Embryo of two unequal cotyledons, each deeply divided into two parts.

DISTRIBUTION: S. India, Ceylon, Malesia (Malesian species all referred to *Shorea* and *Hopea*, except *Neobalanocarpus heimii*).

ECOLOGY: Wet evergreen lowland tropical forest.

NOTE: Beddome described two species: *B. erosa* and *B. utilis*. Dyer (J. Bot. 3: 154. 1874) concluded that his *Hopes longifolia* (Fl. Brit. Ind. 1: 309. Jan. 1874) based on Beddome s.n. from Thinnevelly, S. India was conspecific with *B. utilis* Beddome (Fl. Sylvat., tab. 330. 1874) and Gamble (Fl. Madras 84. 1945) accepted the reduction.

Bole (Kew Bull. 1951: 145–146) discussed the status of *Dioticarpus barryi* Dunn (Kew Bull. 1920: 337). a genus that Dunn had separatated from Balanocarpus, because of the 2-winged fruit. Bole examined the two only fruit bearing specimens of *D. barryi* in the Madras Herbarium (Coimbatore 3463, the type specimen at Kew has no fruit, neither drawing of a fruit) and arrived at the following conclusions, having studied the literature of Malesian species.

"Foxworthy (J. Arnold Arb. 27: 347. 1946), in his account of the distribution of Dipterocarpaceae, is inclined to consider *Balanocarpus erosa* Bedd. as a species of *Hopea* Roxb. The author (Bole) of the present note very reluctantly has to disagree from such a view untill further anatomical and morphological evidence be brought forward. The fruit morphology of these two species of *Balanocarpus* (i.e. *B. erosa* and *B. heimii* King) is so different from that of *Hopea*, that either retention in a separate genus seems to be justified".

How Ashton (Blumea 29(2): 369. 1972), who quotes Bole, can conclude: "Bole's correct reduction of the genus *Balanocarpus* to *Hopea*" is a riddle as Bole concluded the opposite. An example of carelessness.

Of *Balanocarpus utilis* Bole believed that is was conspecific with *Dioticarpus barryi* Dunn, but as he was aware, that the fruit of Dioticarpus had 2 wings and Balanocarpus no wings, he made the nonsensical assumption, that both kinds of fruit could occur on the same tree, "this point needs further elucidation from field workers" (Bole, apparently, was never in the field).

But not with standing Bole's own suggestion for waiting for confirmation, he proceeded to refer *Balanocarpus utilis* to *Hopea*, giving *Dioticarpus barryi* as a synonym.

It goes without saying that *Balanocarpus* is not a proper *Hopea* and that *Dioticarpus barryi* is not conspicific with it. The latter should be compared with *Hopea wightiana*.

Van Slooten (Reinwardtia 3(3): 315–320. 1956) discussed the vagaries of

Balanocarpus. Symington (Gard. Bull. Str. Settl. 7: 129, 153. 1933) created *Balanocarpus multiflorus* (Burck) Sym. One year later (Gard. Bull. 8: 26–29. 1934) he expressed his dissatisfaction with the genus Balanocarpus and prophesixed that its demise was imminent. This was carried out in 1938 (Gard. Bull. 9: 330).

Van Slooten agreed with this, pointing out that the main characteristic, the wingless fruit, is not a criterium in other Dipterocarp genera to separate them from wing-bearing ones. A rather weak argument.

Ashton (Fl. Males., l.c. 391) reduced *Balanocarpus* to *Hopea*, with exception of *B. heimii*, for which he created a separate genus *Neobalanocarpus* (Fl. Males., l.c. 388). Maury-Lechon (Thesis, l.c. 3 1A: 56, 91; 1B: 371) maintains *Balanocarpus heimii*.

So far, there is no consensus of the status of *Balanocarpus*. The approach by foresters (Symington, Ashton), by anatomists (Maury-Lechon) and by taxonomists, has given rise to different systems and maintenance of different genera.

If *Balanocarpus* has to be fused with another genus, the logical choice is *Shorea*, because of the 3 slightly larger at base thickened sepals under the fruit, but the number of stamens militates againts *Shorea*, but stamen number seems to be inadaequate to separate dipterocarp genera.

In order not to commit myself with unfounded conclusions, I have maintained *Balanocarpus*.

In his Manual of Dipterocarp trees of Brunei State (91. 1964) Ashton included the 3 Ceylonese species of *Hopea* (including *Balanocarpus brevipetiolaris*) in the section *Hopea*, characterized by scalariform nervation and smooth bark or regularly flaky. Since then he included *Balanocarpus brevipetiolaris* in *Hopea* with reticulate venation, upsetting his own sectional subdivision. *B. brevipetiolaris* is very close to *B. kitulgallensis*, the latter with scalariform reticulation. By creating sections, based on nervation, closely related species may become widely separated and taxonimists, contrarily to foresters (Ashton) do not base sections on nervations only.

Key to the Ceylonese species

1. Leaves coriaceous, venation reticulate, subacuminately gradually tapered, 3–5 × 7–14 cm, with 5–7 pairs of lateral nerves ..... 1. *B. brevipetiolaris*

1. Leaves chartaceous, secondary nerves scalariform, caudate- acuminate, 2–3.5 × 4.5–5 cm, with 3 (rarely 4) pairs of lateral nerves ..... 2. *B. kitulgallensis*

1. *Balanocarpus brevipetiolaris* (Thw.) Alston — Fig. 32

in Trimen, Handb. Fl. Ceylon 6: 26. 1931; Ashton in Fosberg & Dassanayake (eds.), Revised Handb. Fl. Ceylon 1(2): 172. 1977 and ibid. 1: 376. 1980, as a synon. of *Hopea brevipetiolaris* (Thw.) Ashton.

Shorea brevipetiolaris Thw. in Trimen, J. Bot. 23: 205, tab. II, fig. 22, 23. 1885; Handb. Fl. Ceylon 1: 130. 1893, as a doubtful synon. of *Balanocarpus (?) zeylanicus* Trim.; Brandis, J. Linn. Soc. 31: 108. 1895; Worthington, Ceylon Trees: 69. 1959; Ashton, l.c.: 172. 1977 and ibid.: 376. 1980, as a synon. of *Hopea brevipetiolaris*; Kostermans, Bull. Museum nation Hist. nat. Paris, 4e Sér., Sect. *B. Adansonia* 2: 175. 1981. — Typus: *Thwaites C.P. 4008*, s.loc., ster. (PDA).

Hopea brevipetiolaris (Thw.) Ashton, Blumea 20(2): 359. 1972; in Dassanayake, l.c.: 172. 1977 and ibid.: 376. 1980.

Balanocarpus (?) zeylanicus Trimen, J. Bot. 27: 161. 1889; Handb. Fl. Ceylon 1: 130, Atlas tab. 14. 1893; Brandis, J. Linn. Soc. 31: 108. 1895; Lewis, Veget. Prod. Ceylon: 43. 1934; Ashton, l.c.: 172. 1977 and ibid.: 376. 1980, in syn. — Type: Unnumbered specimen in bud from a cultivated tree in the Botan. Gard., Peradeniya (PDA).

Tree, up to 20 m high, dbh. 90 cm, coppicing at the base, bole regular, sometimes branchlets pendulous. Buttresses none or small; bark smooth, greyish to tawny brown, in older trees rough, dark brown, peeling in strips, thin, live bark pale yellow brown, sapwood dark brown, hard. Pendulous branches very densely brown puberulous (hairs erect), dissapearing on non-pendulous ones. Stipules narrowly triangular, 1—2 mm, early caducous. Leaves coriaceous, glabrous, ovate, 3—5 × 7—14 cm, gradually tapered to a blunt, subacuminate acumen, base rounded to cordate; above glossy dark green, smooth, midrib slender, impressed, lateral nerves inconspicuous or slightly impressed; below paler, glossy, midrib rather slender, prominent, lateral nerves slender, rather erect, slightly arcuate, prominulous, 5—7 pairs, sometimes with pits in the axils; secondary nerves not scalariform; reticulation obscure. Petiole 4—13 mm long, either very densely puberulous (hairs erect) or glabrous, slit-like channeled above.

Panicles slender, 1—3 from leaf axils, singly branched, 4—18 cm long, slightly (denser on basal part of main peduncle), very minutely puberulous, the spreading, alternate branches slender, up to 5 cm long, bearing 5—10 flowers. Pedicels slender, 1—2 mm long. Sepals broadly ovate, acutish, subequal, 2 mm long, free to the base, erect-patent. Petals pale yellow, slightly connate at base into a cup-shaped urceolate cup, 4 mm long (dropping as a cup-shaped rosette, 4—5 mm in diam., apical part convolute sideways). Stamens (from 9 to 15), some opposite the others, irregular (in one tree), very small; filaments long, white, very broadly triangular, the apical part filiform, anthers 0.25—0.50 mm, subglobose, connectivital appendage filiform, acute, as long as the anther. Ovary smooth, elongate ovoid with as long, acute, narrowly conical style.

Fruit elongate ovoid, acutish, apiculate, glossy, smooth, up to 13 × 10 mm, striated, pericarp thin, brittle, the persistent calyx lobes adpressed to the fruit, glabrous, ovate orbicular, the 3 outer ones thicker, thickened at the base, hardly longer than the inner two, up to 5 mm long. Embryo green; each of the unequal cots completely divided into two parts (Trimen).

DISTRIBUTION: Now only found on the slopes and the summit of Doluwe and Dun Kande, near Kurunegala, up to 600 m altitude; as trees are found at the base of Dunkande near Arankelle and at hills opposite it, it may be assumed that the species must have been common also in the plains between the hills.

ECOLOGY: A normally developed tree with straight bole of 20 m high, was found at the base of Dunkande near Arankelle. The tree is extremely common on the flat top of Doluwe Kande at 600 m altitude and its adjacent slopes, but because of adverse conditions it is here stunted with short, crooked boles, sprouting several boles, and more coppicing than the trees lower down, (although these have numerous root-suckers), (the so-called

Bonsai-effect). The bark of older, regular tree boles looks quite different from the smooth, greyish younger stages. Trees with long pendulous branches were seen occasionally.

NOTE: The type specimen is a sterile shoot from an unknown locality (Ashton says from Doluwe Kande, perhaps based on an assumption). It shows the deeply cordate leaves and dense puberulence of a young tree. Trimen stressed that its origin was not known and he added it to the synonyms of his own species: *Balanocarpus zeylanicus* with an iterrogation mark, stressing in a note, that Thwaites's sterile shoot might represent another species. As *B. zeylanicus* is based on another type specimen, Trimen did not transfer *Shorea brevipetiolaris* Thw. to *Balanocarpus*, as Ashton says, but created a new species, adding in synonym as a doubtfull synonym *Shorea brevipetiolaris* Thw. and hence his name is not illegitimate (as Ashton says).

There is one specimen in Peradeniya with flowers in bud, collected in the Peradeniya Garden, which is probably the specimen mentioned by Trimen. I have indicated this as the lectotype specimen.

In the description Ashton calls the tree "medium sized, but up to 35 m tall and up to 3 m girth". This is perhaps a mistake for feet (not meters). The petals are more orbicular-ovate to orbicular then oblong-ovate as described by Ashton and their enrolled, oblique tip which is so characteristic, is not described, neither the cup-shaped or urceolate corolla. The statement, that there are 10 or 15 stamens is wrong, I have counted them in 50 flowers; there are 9, 10, 11, 12, 13, 14 or mostly 15 stamens, some opposite each other. The garden specimen flowered in May, during 2 weeks after a long (4 weeks) period of flower development.

The name *Dunmala*, given by Ashton is wrong. *Dummala* (not *Dunmala*) means resin and is given to any Dipterocarpaceous tree, when no other name is known (*dummala* from dhuma, Sanskrit = fume, used as an incense). Our tree produces hardly any resin and nobody collects it.

Ashton 2053, Doluwe Kande, ster. (PDA); 2105, cult. in Botan. Garden, Peradeniya, April, buds (PDA); *de Silva 49, 51, and s.n.*, May, fl. (PDA); *s.n.*, Aug., fr. (PDA); *Jayasuriya & Balasubramaniam 537*, Kurunegala, Dunkande, Arankelle, ster. (PDA); *540*, Doluwe Kande (PDA); *Kostermans 28441*, cult. in Botan. Garden, Peradeniya, April, fl. (AAU, G, L); *28459*, Kurunegala, Dunkande, Arankelle, May, fl. (PDA); *28467*, Doluwe Kande, May, buds (AAU, G, L, PDA); *Livera s.n.*, cult. in Botan. Garden, Peradeniya, June, young fr. (PDA); *Meijer 372*, Kurunegala, Dunkande, Arankelle (PDA); *819*, cult. in Botan. Garden, Peradeniya, July, young fr. (PDA); *J. M. Silva s.n., eod. loc.*, July, fr. (PDA); *ibid.*, April, buds (PDA); *s. coll. C.P. 4008*, Kurunegala Distr., N.W., ster. (PDA); *s. coll., s.n.*, Doluwe Kande, Sept. 1888, young fr. (PDA); *ibid.*, May 1884, buds (PDA); *ibid.*, Dec. 1888, young pl. (PDA); *ibid.*, cult. in Botan. Garden, Peradeniya, Jan. 1888, fl. (PDA).

2. *Balanocarpus kitulgallensis* Kosterm. — Fig. 33

Bull. Museum nation Hist. nat. Paris, 4e Sér., Sect. *B. Adansonia* 2: 177. 1981.

— Typus: *Kostermans 28385* (L).

Tree 6 m, dbh. 10 cm. Bark smooth, light brown, thin. Live bark 3 mm,

light brown. Branchlets sub-pendulous, slender, densely pubescent (hairs erect). Leaves chartaceous, ovate, 2–3.5 × 4.5–5 cm, caudate-acuminate (acumen slender, up to 1.5 cm long), base rounded; above glossy, glabrous, except the slightly prominulous slender midrib (may be also level with the surface), which is densely pilose, lateral nerves faint; below glabrous, except hirsute domatia in the axils of the strongly arcuate, 3 (rarely 4) pairs of slender, prominent lateral nerves, midrib slender, prominent, secondary nerves faint, prominulous, parallel, all horizontal. Petiole slender, 5–8 mm long, very densely pubescent (hairs erect).

Infructenscences axillary, filiformous, very sparsely, very minutely puberulous, rather few-flowered, few-branched, paniculate, up to 5 cm long, the longest filiform branches 2 cm long.

Fruit almost sessile, sub-globose, up to 8 × 10 mm, glabrous, glossy, the 5 sepals of about equal length, thickened at the base, strongly imbricate, ca. 10 mm long, ovate, acutish, the basal 1–2 mm connate. The 3 outer slightly larger and thicker. Fruit elongate-ovoid, acute, smooth, glossy with style remnant.

DISTRIBUTION: Only known from the type locality.

NOTE: Close to *B. brevipetiolaris*, but differs by the smaller, chartaceous leaves with few (3 versus 5–7) pairs of lateral nerves, a more minute reticulation and typical horizontal, parallel secondary veins, the filiform, almost glabrous, much smaller panicles (not panicles of racemes) and the almost sessile fruit (flowers). Stamens were not present at the time of collection.

Kostermans 28385, Kitulgalle, across Kelaniya R. near a flat rock-bottommed tributary, which ends opposite the Kitulgalle Resthouse, alt. 150 m, May, young fr. (AAU, G, L, PDA); *28485, ibid.*, May, ripe fr. (AAU, G, L, PDA)

Ashton (Gard. Bull. Singapore 31: 27. 1978) accomodated *Balanocarpus heimii* King in a new genus: *Neobalanocarpus* Ashton. He gave it the status of a *nomen novum*, but it is a new genus and hence the name is invalid. I wrote this to Ashton and van Steenis described the new status in Fl. Malesiana (without acknowledgment).

9. *Stemonoporus* Thwaites

in Hooker's Kew J. Bot. 6: 67. 1854; Enum. Pl. Zeyl.: 37. 1858; *ibid.*: 403. 1864, as a synon. of *Vateria*; Bentham in Benth. & Hooker f., Gen. Pl. 1: 194. 1867, as a synon. of *Vateria*; A.DC., Prod. 16(2): 620–623. 1868, as a synon. of *Vatica*; Thiselton-Dyer in Hooker f., Fl. Brit. Ind. 1: 313. 1874, as a synon. of *Vateria*; Trimen, Syst. Catal. Pl. Ceylon: 9–10. 1885; Handb. Fl. Ceylon 1: 132. 1893; *id.* 5 (Hooker f.): 382–384. 1900; Heim, Recherches Dipter.: 88. 1892; Alston, Handb. Fl. Ceylon 6 (Suppl.): 25–27. 1931; Lewis, Veget. Prod. Ceylon: 44. 1934; Ashton, Blumea 20: 363. 1972; *in* Fosberg & Dassanayake (eds.), Revised Handb. Fl. Ceylon 1(2): 187. 1977; reprint 1: 404–418. 1980; Maury-Lechon, Dipterocarpacées. Du fruit à la Plantule, Thesis 1 A: 66, 70, 92, 124, 149, 204 (2 groups: "*St. ronds*" and S.

"ovoides"). 1978; Kostermans, Bull. Museum nation. Histoire nat., Paris, 4e Sér., 3, Sect. B. Adansonia no. 3: 321–358. 1981; id. no. 4: 373–465. 1981. — Lecto type species: *St. gardneri* Thw.

Monoporandra Thwaites in Hooker's Kew J. Bot. 6: 69. 1854; Enum., *l.c.*: 39. 1854; *ibid.*: 404. 1864, as a synon. of *Vateria*; Bentham, *l.c.*: 194; A.DC., *l.c.*: 636; Dyer, *l.c.*: 316; Trimen, Cat., *l.c.*: 10; Handb., *l.c.* 137; *id.* 5 (Hooker f.): 383–384. 1900, excl. *S. lewisianus*; Lewis, *l.c.*: 51; Alston, *l.c.*: 21, as a synon. of *Stemonoporus*; Ashton, *ll.cc.*, as a synon. of *Stemonoporus*. — Lectotype species: *Monoporandra cordifolia* Thw.

Vesquella Heim, Recherches Dipter.: 90. 1892; Bull. Soc. Bot. France 39: 153. 1892; Brandis, J. Linn. Soc. 31: 139. 1895; Hooker f. in Trimen, Handb., *l.c.*: 383. 1900; Ashton, *ll.cc.* Kostermans, l.c. — Type species: *Vesquella acuminata* (Thw.) Heim.

Sunapteopsis Heim, Recherches Dipter.: 92. 1892; Brandis, *l.c.*: 139; Hooker f., *l.c.*; Ashton, *ll.cc.;* Kostermans, l.c. — Type species: *Sunapteopsis jucunda* (Thw.) Heim, combination not printed.

Kunckelia Heim, Bull. Soc. Bot. France 39: 153. 1892; Recherches Dipter.: 92. 1892 "Kuenckelia"; Brandis, *l.c.*: 139; Hooker f., *l.c.*; Ashton, *ll.cc.;* Kostermans, l.c. — Type species: *Kunckelia reticulata* (Thw.) Heim.

Vateria (non L.) Thwaites, Enum., *l.c.*: 403. 1864, excl. *V. disticha* and *V. scrabiuscula* Thw.

Resinous trees, the majority small, rarely reaching timber size (*S. acuminatus* and *S. gardneri*). Crown open. Bark smooth, grey, hoop-ringed. No buttresses. Branchlets and terminal buds in a young stage as a rule covered by a microscopical fugaceous pubescence (except *S. moonii* long hairs), hairs simple, sometimes microscopical flat scales (cf. Maury, Thesis). Buds small. Stipules small (except *S. moonii*), caducous (except in *S. moonii*). Leaves penninerved (very rarely triplinerved) with distinct or indistinct scalariform secondary nerves on the lower surface. Midrib thin, prominulous or impressed on the upper surface, prominent and often initially puberulous on the lower one, lateral nerves near the margin usually rather abruptly arcuately ascendent, unconnected or connected into a marginal vein; lower leaf surface in flush sometimes very sparsely puberulous. Petioles with thickened apical part, geniculate or not, very variable in length in the same species.

Inflorescences axillary and extra-axillary, paniculate in principle, but the main peduncle usually very short, the inflorescence seemingly in bundles, the branches often so short, that the panicles becomes a few-flowered raceme, sometimes the whole reduced to a single flower. Branchlets and base of main peduncle with caducous bracts, base of pedicel bracteolate, caducous, except in *S. moonii*. Flowers hermaphroditic; sepals 5, imbricate in bud or almost so, patent, usually puberulous outside, large, compared with the petals. Pedicels usually short. Petals 5, imbricate at the base in expanded flower, usually longer than sepals, glabrous, pale yellow or white, rotate, falling as a whole. Stamens 5 or 15 (rarely 10–13), in one or two whorls, 10 external, 5 internal slightly shorter, forming a cone-like structure around the style; filaments coalescent, very short, narrowly triangular; anthers long, very narrowly triangular, usually densely puberulous, the two valves much different in length, the larger one with incurved margins, touching in one place (rarely over the entire length), where the margin bulges, forming a long oblique

orifice apically and a straight one below the bulges, very rarely flat and open (*S. lancifolius*); no connective appendage; the tip of the oblique aperture apiculate, acute or obtuse; the small valve with a central, longitudinal rib. Ovary globose to conical, usually ribbed, puberulous or glabrous; style longer, tapering, stigma minute, acute, exserted or not from the staminal cone (style articulate with ovary in some species (Brandis, 1895). Ovules pendulous, anatropous.

Fruit one-seeded by abortion, as a rule spherical of depressed spherical, rarely conical (*S. kanneliyensis*) or pointed (*S. reticulatus*), roughing because of a pattern of minute, polygonal areas; sepals persistent, either unaltered, adpressed to the base of the fruit or patent or hardened and slightly enlarged, pointing downward, in *S. kanneliyensis* and *S. reticulatus* much thickened and pointing downward. Cotyledons small and simple or large, lobed, dissected and folded, green or red. No albumen. Germination: the fruit with the thick pericarp (*S. kanneliyensis, S. reticulatus* perhaps *S. wightii*) dehisce by valves, along the depressions: the thin or thinner skinned fruit crack irregularly, even when then are ribbed in immature stage. The hypocotyledon lengthens considerably and lifts the cots above the ground; they either remain in the pericarp (*S. kanneliyensis*) or unfold, become horizontal, fleshy, large, thick, wrinkled and incised, red or green. Cots equal or unequal. In some species at the base inside of the pericarp a fleshy cup with laciniate margins; sometimes a fibrous mass between the cots (Heim, Brandis). The first leaves are, as in *Vatica*, whorled.

DISTRIBUTION: Wet zone in the S.W. parts of the island, in the Adam's Peak jungle and in the Knuckles Mts. at altitudes from sea leavel to 1700 m.

ECOLOGY: Always in the wettest parts, many along streams and streamlets in the wet zone. Occurrence independent of depth of soil or kind of soil. Often in small populations far apart. Only a few reach timber size. They flower in definite periods after rainfall, once or twice a year. Flowers few. Fruit setting is rare to very rare (hence the trees are rare). Pollination by beetles, bees, butterflies.

HISTORY

Since the inception of the genus *Stemonoporus* by Thwaites in 1854, it has moved through *Vateria* and *Vatica* and has nowadays been re-established as a proper genus. This implies that the generic delimitations, especially in the *Vatica* group (*Vatica, Stemonoporus, Cotylelobium*) are not satisfactorily solved. The trees of the three genera look much alike, and are in Ceylon known under one collective vernacular name: Mendora, Whereas in *Shorea* and *Hopea* all genera with more or less similar fruit characters are combined, this is not the case in the *Vatica* group and this inconsistency is one of the reasons of the unsatisfactory situation.

Thwaites originally recognized 11 species under *Stemonoporus* and 3 under *Monoporandra*. Under the influence of Bentham, he referred them all to *Vateria* in the Addendum of his book in 1864, even quoting Bentham as the author of the new combinations (this is under the latest Rules not admissable, the combinations should be printed to be valid and not only suggested, as Bentham did). Thwaites even went one step further than Bentham and moved

also *Monoporandra* to *Vateria*. Thiselton-Dyer followed suit, but meanwhile A. de Candolle had reduced *Stemonoporus* to *Vatica*, but — like all other botanists — up to Alston, kept *Monoporandra* separate.

In his Addendum Thwaites added (under *Vateria*) 3 new species, of which *Vateria (Stemonoporus) acuminata* belongs, but *Vateria (Stemonoporus) scabriuscula* and *V. disticha* are respectively *Sunaptea* and *Doona*. This makes a total of 15 proper *Stemonoporus* species. The same number is enumerated by De Candolle under *Vatica*.

Dyer has a total 14 species, because he reduced *Monoporandra lancifolia* to a variety of *Vateria (Stemonoporus) nitida*.

Trimen described 13 species in *Stemonoporus* and 2 in the reinstated genus *Monoporandra*.

Hooker added in the 5th volume of Trimen's Flora in 1900 two more species, of which one (*S. lewisianus*) was referred by Alston to *Vateria*, by Livera to *Vatica*, by Ashton to *Cotylelobium* and by me (cf. under that species) reinstead as a *Vatica*, which brings the number to 16 species.

Alston reduced *Monoporandra* to *Stemonoporus* and has the same 15 species.

Ashton ultimately restored *S. lancifolius*, but excluded *S. moonii* and hence has still only 15 species.

The reasons, why there were no additional species described was the cessation of collecting in the lowland ever-green forests, which had already been neglected under Trimen.

After a dormant period of almost 80 years the resumption of collecting in the above mentioned areas, of which Hooker already predicted, that they should yield many novelties, yielded a surprising number of 8 new species, and the chances are big, that this is not the end.

Of the 15 species known to Thwaites, so far 2 had not been recollected.

Heim (1892) included *Stemonoporus* (subdivided into *Eustemonoporus* and *Monoporandra*, as accepted in this paper) in Stemonoporées, together with *Vesquella* and the doubtful genus *Sunapteopsis* (the same year reduced by him to *Vesquella*); there is a subseries of *Kunckelia*.

The Stemonoporées are kept separate from the Vateriées and the Vaticées. Guerin (Compt. Rend. Acad. Sci., Paris, 140: 520. 1905; *ibid.*, 142: 102. 1906; *ibid.*, 53: 186. 1906; *ibid.*, 58: 9. 1911, n.v., added to the generic descriptions characters of the sectorial organs, muscilafe cells, anatomy, of flowers fruit and leaves (cf. Maury, Thesis, vol. 1 A: 22. 1978).

Gilg, *in* Engler & Prantl, Nat. Pflanzenfam., ed. 2, 21: 589. 1925, included *Stemonoporus* and *Monoporandra*, together with *Vateria* in *Vateriae* (cf. Maury, l.c.).

CHROMOSOME NUMBER: *Stemonoporus: n* = 11; also of *Dipterocarpus, Anisoptera, Vatica, Vateria* (K. Jong and others, n.v., cf. Maury, l.c.: 28).

POLLEN: *Dipterocarpaceae* have no endexine, the tricolpate pollen have a wall of only two strata (cf. Maury, l.c.: 31, 32, and plates vol. II: p. 23, 27 and 29).

EMBRYO AND SEEDLING: Maury (1 A: 92) recognises several types and subtypes according to the implantation, inclination, position and folding. Seedlings are discussed on p. 124.

MORPHOLOGY

Salient morphological characters may be found in the general generic description. A few are discussed here. Trichomes are always simple hairs, extremely short, thickish, conical, half adpressed; in some specimen microscopical flat round scales were observed (resin?). All trichomes are fugaceous, except in *S. moonii* where the hairs are very long and persistent (cf. Maury, Thesis. vol. 1A).

"In *S. wightii, S. petiolaris* and *S. reticulatus*, there is a considerable number (25–50) of resin ducts in the circumference of the pith, the ducts are somewhat unequal in size, the largest have a diameter of 10–15 times that of average pith cells, and they are filled with a solid whitish resinous substance. In the lower half of the internode three of those ducts prepare to enter the wood, which may be seen by a fan-shaped arrangement of the medullary rays. One of these is at the apex of the pith, under the petiole at the top of the internode, the other two are lateral. Contrary to general rule, the apical ducts precedes the two lateral ducts; in the upper half of the internode the apical leaf trace has separated from the central cylinder and has entered the bark, while the two lateral leaf traces have not yet been formed. The apical leaf trace very soon separates, first into 3, and afterwards into 5 distinct vascular bundles, one at the apex and two at each side opposite to each other, thus resembling an imparipinnate leaf. Eventually the petiole is formed exclusively by the apical leaf trace. At the node the two lateral leaf traces have arrived in the bark, and enter the stipules. I have also found branches separating from the apical leaf trace entering the stipules. It will be of interest to know whether this peculiar arrangement is found in other species." (Brandis, 1895).

The petiole length is very variable in the same tree and cannot be used as a distinctive character. "The petiole of *S. wightii* at the base of the blade has an outer horseshoe of vascular bundles with 16, an inner semicircle with 6, and a central mass with 11, total 33 ducts; that of *S. rigidus* and *S. acuminatus* has 9–11 ducts in the outer semicircle and two in the central mass (Pierre); while *S. reticulatus* has 13 ducts in the outer semicircle and none in the central mass" (Brandis, J. Linnean Soc. 31: 138. 1895).

In 2 species (*S. moonii* and *S. lancifolius*) the leaves are triplinerved or subtriplinerved.

The lateral nerves, always more pronounced on the lower surface, have usually a very characteristic abrupt bend upwards near the margin; only in a few cases a real marginal vein is present, formed by the ends of the lateral nerves. The secondary nerves (intercostals) are always scalariform and fairly numerous, those near the midrib are perpendicular to the midrib, towards the margin they become perpendicular to the lateral nerves. In some species they are lacking completely and these leaves resemble strongly those of the 3 endemic *Vatica* species.

The petiole may be geniculate or straight, even in the same specimen and this character has no diagnostic value.

Inflorescences, axillary and extra-axillary, are in principle panicles, showing reduction to racemes and single flowers, but their paniculate origin is always indicated. They are contrarily to those of *Vatica, Shorea* and *Hopea* few to very few flowered, except in *S. wightii*. Deciduous bracts and bracteoles are present, persistent in *S. moonii*.

The flowers are not more nodding than those of *Vatica*, *Shorea* or *Hopea* species. The corolla lobes fall as a whole; fully expanded they are hardly imbricate. The characteristic anthers have been misinterpreted by Ashton. In one case the outer large valve had no involute margins and did not have a tubular aperture. Brandis states that some species have an articulate style (to the ovary), others not. The stigma is acute, punctiform, inconspicous.

Fruit: Maury (Diptérocarpacées, du fruit à la plantule, Thèse, 1978) recognized (vol. I A: 66, vol. I B: 367) in *Stemonoporus* two types of fruit, which according to her are important enough to create two subgenera: "*Stemonoporus* ronds" and "*Stemonoporus* ovoïdes". These two subgenera, named *Sphaerae* and *Ovoides* in vol. I B, p. 371 bis, are not properly described according to the rules of nomenclature.

Of the "*Stemonoporus* ronds" she could study 3 species: *S. affinis*, *S. lanceolatus* and *S. oblongifolius*. They are characterised by globose fruit which at germination crack irregularly, a thin pericarp, encircling cotyledons and a typical anatomy of the radicle. As Heim created for *S. oblongifolius* the genus *Vesquella*, the correct name for the subgenus should be *Vesquella* Heim.

Of the "*Stemonoporus* ovoides" she could study *Stemonoporus canaliculatus* and *S. reticulatus*. They are characterized by the thick-skinned, ovoid, pointed fruit, 6-lobed, at germination dehiscing by valves, and different anatomy of the radicle. As *S. reticulatus* is the base of *Kuenckelia* Heim, the correct name of this subgenus is *Kunckelia* Heim.

In general I agree, that there are apparently two kinds of fruit, characterised by their dehiscence during germination, probably correlated with the thickness of the pericarp and the shape of the fruit. At this stage I am not inclined to create subgenera for these, as most of the *mature* fruit of *Stemonoporus* species are still unknown.

My own findings are, that there are moreover other fruit groups, characterised by simple plan-convex cotyledons and others by folded, encircling, much lobed and dissected, large cotyledons.

Of the conical, pointed, thick-skinned fruit, dehiscent by valves I know only *S. kanneliyensis* and *S. reticulatus*. Maury mentions also *S. canaliculatus*, which is apparently a misidentification for *S. kanneliyensis* as true *S. canaliculatus* has thin-skinned, globose fruit, cracking irregularly during germination. In *S. kanneliyensis* the dehiscence is between each pair of ribs, in *S. reticulatus* along the grooves.

The species with round, thin-skinned fruit form the greater part of the species. From the few cases available it seems that the originally ribbed and grooved fruit, becomes smooth at maturity. Furthermore there are thin-skinned and less thin-skinned fruit in different species.

Maury could study only 5 species, and I have not seen many mature fruit of all species, I prefer to postpone sub-division according to fruit (which then should be called series, as there are already two subgenera).

The remarkable fleshy cup with laciniate margin at the inner base of the perianth, is not mentioned by Ashton. It was the base of HEIM's genus *Vesquella*. As Brandis said: "these are of utmost importance and should be studied in other species".

The cotyledons are either equal or unequal; albumen was found in a very young stage. They are usually very fleshy, folded and lobed, an exception is *S. angustisepalum*.

The reason, why most species are so rare, is that the fruit setting is often poor to very poor. Moreever the seedlings are extremely sensitive to drought and a week of no rain will cause death, as I could observe with cultivated specimens. Hence they are restricted to extremely wet parts, even on exposed rocks they grow only when these are wet. They are very easily detached and drop immature. Maturing takes a long time and augments the hazards. Fruit are often attacked (galls).

They usually grow in small populations, with expand only slowly because of their poor fruiting abilities and sensitiveness to drying out. As far as I could see there is no connection with the type or depth of soil as imagined by Ashton. No animal eats the fruit.

TAXONOMY

There is no doubt that *Stemonoporus* belongs in *Vateriae*. It is distinguished mainly by the peculiar anthers, although they resemble those of *Vatica*. There is never a real connectival appendage. Two groups of fruit can be distinguished, one has spreading , not hardened sepals under the fruit, the other has the sepals hardened and enlarged and pointing downward, like in part of *Vatica*. Epigeal and hypogeal seed development both occur; but in all cases the lenghtening of the hypocotyledon, lifts the cotyledons far above the ground.

If the system of combining all smaller genera in one large one as in *Shorea* and *Hopea* is advocated with their subgenera, it would be for the sake of consistency also advisable to combine all *Vateriae* into *Vatica*, as was done by A. de Candolle.

Because of the importance of the shape of the anthers in the family Dipterocarpaceae, the genus *Stemonoporus* is very aberrant and hence might be of a different origin than the other dipterocarp genera.

Key to the species

1. Stamens 5. Ovary 2- (rarely 3-) celled.

   2. Lateral nerves very obscure on the lower leaf surface..... 24. *S. elegans*

   2. Lateral nerves very conspicuous, prominent on the lower leaf surface.

      3. Leaves elliptic, 15–25 × 5–9 cm, strongly concave and pendulous
      26. *S. scaphifolius*

      3. Leaves elliptic, 5–15 (–17) × 3–8 cm, acumen 4–10 mm long; lateral nerves 8–11 pairs. Pedicel thickish, 2–3 mm long. Sepals narrowly lanceolate
      25. *S. angustisepalum*

      3. Leaves ovate to oblong-ovate, 3–11 × 1–5.5 cm; acumen 1–3 cm long. Lateral nerves 6–7 pairs. Pedicels filiform, 10 mm long. Sepals narrowly ovate-lanceolate
      23. *S. cordifolius*

1. Stamens 15 (rarely 10–13). Ovary 3-celled.

   4. Leaves triplinerved or sub-triplinerved.
      5. Stipules very long, slender, persistent. Brachlets thick, apically with long, rufous hairs..... 22. *S. moonii*

5. Stipules minute, caducous. Branchlets slender or rather slender with fugaceous, microscopical indumentum..... 1. *S. lancifolius*

4. Leaves penninerved.

6. Distinct marginal nerve present. Leaves bullate above (cf. also *S. canaliculatus*).

7. Leaves 35–41 × 14.5–17 cm. Lateral nerves 20–26 pairs ..... 2. *S. marginalis*

7. Leaves 20–35 × 7–12 cm. Lateral nerves 16–18 pairs ..... 35. *S. bullatus*

6. Lateral nerves (at least in the lower part of the lamina) not connected or not all connected into a conspicuous marginal vein.

8. Midrib impressed on the upper leaf surface.

9. Fruit ovoid-acute, or conical-acute, large, thick- skinned, dehiscent by valves.

10. Leaves subovate-elliptic, rarely elliptic, 11–23 × 5–8 cm; lateral nerves 10–18 pairs. Secondary nerves on lower leaf surface conspicuous, scalariform. Fruit conical, up to 4.5 cm high ..... 4. *S. kanneliyensis*

10. Leaves elliptic, more rarely subovate-elliptic, 6– 15 × 3–5 cm; lateral nerves 10–11 pairs. No secondary nerves on the lower leaf surface (not differentiated from the reticulation). Fruit ovoid, acute, 3.5 cm high 11. *S. reticulatus*

9. Fruit globose or subglobose, obtuse, thin or rather thin-skinned, dehiscent by irregular cracks.

11. Leaves obtuse, sometimes slightly emarginate..... 5. *S. revolutus*

11. Leaves acuminate.

12. Leaves caudate-acuminate with slender, 1–3 cm long acumen. Small trees, up to 4 m tall..... 6. *S. gracilis*

12. Leaves broadly, abruptly acuminate, acumen 5–20 mm long. Trees up to 15 m tall.

13. Leaves rigidly coriaceous, ovate to ovate-oblong, the basal lateral nerves often proximate. Pedicel fleshy, 3–6 mm long. Tree up to 70 cm diam..... 7. *S. gardneri*

13. Leaves thinly coriaceous, elliptic-lanceolate, basal lateral nerves aequidistant. Flowers sessile. Tree bole up to 10 cm diam. ..... 8. *S. canaliculatus*

8. Midrib on the upper leaf surface prominulous or prominulous in a groove.

14. Secondary nerves (intercostals) invisible on the lower leaf surface.

15. Lateral nerves 4–6 pairs ..... 9. *S. nitidus*

15. Lateral nerves 12–16 pairs ..... 10. *S. laevifolius*

14. Secondary nerves (intercostals) conspicuous on the lower leaf surface.

16. Inflorescence a large, broad, up to 15 cm long, many-flowered

panicle ..... 15. *S. wightii*

16. Inflorescence very few flowered, short (up to 5 cm long), pseudoracemes, or flowers sessile.

17. Leaves obtuse (very rarely very shortly apiculate) or emarginate.

18. Leaves 22–35 × 10–15 cm. ..... 16. *S. gilimalensis*

18. Leaves up to 14 × 5 cm.

19. Extremely rigid leaves. Lateral nerves impressed on the upper leaf surface ..... 12. *S. rigidus*

19. Leaves rigidly coriaceous. Lateral nerves prominulous on the upper leaf surface ..... 13. *S. oblongifolius*

17. Leaves broadly and shortly to long and slender acuminate.

20. Leaves chartaceous. Acumen very slender, with parallel margins, up to 2 cm long. Petiole slender, (2–) 7.5 cm long 14. *S. petiolaris*

20. Leaves sub-coriaceous to stiffly coriaceous. Acumen broad, short (except in *S. lanceolatus*, where it may be up to 2.5 cm long, but then the petiole thick and only up to 2.5 cm long).

21. Flowers sessile ..... 17. *S. scalarinervis*

21. Flowers pedicellate.

22. Inflorescence a raceme, 1–5 cm long.

23. Raceme peduncles very slender. Leaves with slender acumen ..... 21. *S. acuminatus*

23. Raceme peduncles thickish. Acumen short, very broad ..... 19. *S. latisepalum*

22. Flowers glomerulate, 1–2 together.

24. Leaves sub-coriaceous, lanceolate to narrowly elliptic. Sepals lanceolate- linear ..... 18. *S. lanceolatus*

24. Leaves stiffly coriaceous, elliptic to subovate-elliptic. Sepals narrowly oblong to subovate-oblong 20. *S. affinis*

Subgenus Stemonoporus

Kostermans, Bull. Museum nation Hist. natur., Paris, 4e Sér., Sect. B., Adansonia no. 3: 330. 1981.

Stamens 15 (rarely 10–13). Ovary 3-celled.

1. *Stemonoporus lancifolius* (Thw.) Ashton — Fig. 34

Blumea 20(2): 365. 1972; in Fosberg & Dassanayake (eds.), Revised Handb. Fl. Ceylon 1(2): 191. 1977, p.p. (excl. *Ashton 2003 & Balakhrisnan 343,*

quoad S. gracilis); reprint 1: 413. 1980; Kostermans in Liber gratulat. de Wit: 216. Wageningen (1980); Bull. Museum nation Hist. natur., 4e Sér. Sect. B., Adansonia no. 3: 330, fig. 1. 1981. — Typus: *C.P. 3412*, Pasdun Korale, Hellesee, Apr., fl. 1855 (PDA, 2 sheets).

Monoporandra lancifolia Thw., Enum. Pl. Zeyl.: 39. 1858; A.DC., Prodr. 16(2): 637. 1868; Trimen, Handb. Fl. Ceylon 1: 137. 1893; Ashton, l.c.; Kostermans, l.c.

Vateria lancifolia (Thw.) Thw., Enum., l.c.: 404. 1864; A.DC., l.c.: 637; Trimen, l.c.; Ashton, l.c.; Kostermans, l.c.

Vatèria nitida var. *lancifolia* (Thw.) Dyer in Hooker f., Fl. Brit. Ind. 1: 316. 1874; Trimen, Syst. Catal.: 10. 1885; Handb., l.c.

Stemonoporus nitidus var. *lancifolius* (Thw.) Trimen, Handb., l.c.: 136 (*auctor sphalm.*: Dyer); Ashton, l.c.; Kostermans, l.c.

Stemonoporus nitidus subsp. *lancifolius* (Thw.) Ashton, l.c.: 139 (*sphalm.* for variety); Kostermans, l.c.

Vateria lanceaefolia (Thw.) A.DC., Prodr. 16(2): 625. 1864, *sphalm.* (= *Vateria lancifolia* (Thw.); Kostermans, l.c.

Monoporandra lanceaefolia (Thw.) A.DC., Prodr., l.c.: 625. 1864, *sphalm.* (= *Monoporandra lancifolia* Thw.); Kostermans, l.c.

Stemonoporus nervosus Thw. ex Trimen, J. of Bot. 23: 206. 1885; Syst. Cat.: 10. 1885; Handb., l.c.: 136; Brandis, J. Linn. Soc. 31: 142. 1895; Ashton, ll.cc., as a synon. of *S. lancifolius*; Kostermans, l.c.

Vateria nervosa Thw. ex Trimen, J. of Bot., l.c.; Typus: *C.P. 3885*, Hewesse, ster., 1865 (PDA); quoted erroneously as 3815 by Trimen in 1885.

Probably small tree, glabrous in all its parts (except anthers). Branchlets and thin, smooth, glossy, terminal bud small, glossy. Leaves sub-coriaceous, glossy and obscurely reticulate on both surfaces, lanceolate, 5–13 × 1–4 cm, long-acuminate (acumen obtuse, 5–20 mm long), base obtuse, very rarely acutish; above midrib thin, prominulous, below slender, slightly prominent, laterals distinct below, 3–6 pairs, prominulous, thin, erect-patent, near the margin abruptly almost erectly ascendent, the lower pair arcuate, more ascendent (triplinerved), secondary nerves thin, parallel, horizontal, numerous. Petiole thin, 5–13 mm long, not geniculate.

Inflorescence axillary with one flower. rarely with 2. Peduncle very thin, up to 10 mm long. Pedicels very thin, up to 15 mm long. Sepals ca. 4 mm long (after anthesis 10 mm), narrowly oblong-ovate, acute, concave, glossy. Petals oblong, acutish, 7 mm long. Stamens 15. Anthers microscopically pubescent. The large valve more than twice the small one, acute, its margin hardly recurved (not "end porus").

Fruit (according to Dyer) ovoid, 25 × 19 mm, pale brown, minutely mottled. Sepals long, pointing downward (according to plate in PDA).

DISTRIBUTION: Only known from the type locality, lowland evergreen forest in S.W. Ceylon.

NOTE: Trimen erroneously quoted Thiselton-Dyer for *Stemonoporus nitidus* var. *lancifolius*; actually Dyer made the variety under *Vateria nitida*. Ashton apparently did not check this and repeated the mistake.

Ashton moreover erroneously quoted it as a subspec. which hence represents a new combination, although unintentionally made.

Ashton mixed two entirely different species. I have segregated part as *S. gracilis*, which even in sterile condition can easily be separated by the impressed midrib on the upper leaf surface and the non-triplinerved leaves.

In the type material at Peradeniya there is a package with a complete flower, which apparently Ashton did not examine, as he failed to note that the anthers are not so-called end-porus.

Only De Candolle commented on the irregular lateral nerves. The triplinervy, mentioned by Trimen in *Vateria nervosa* in 1885, was completely overlooked by others, although it is quite distinct, the subbasal nerves being also different in shape from the other ones.

Dyer described a fruit: I have seen none, I have copied his description. The plate in PDA shows this fruit with reflexed sepals.

The species was originally included in *Monoporandra*; Dyer moved it to *Vateria* because of the 15 stamens.

C.P. 3412, S.W. Ceylon, wet, evergreen lowland forest, fl., Apr. 1885 (PDA, 2 sheets); *C.P. 3885*, Hewesse, ster., Sept. 1885 (PDA).

2. *Stemonoporus marginalis* Kosterm.

Bull. Museum nation Histoire natur., Paris, 4e Sér., Sect. *B. Adansonia* no. 3: 332, 1981. — Typus: *Ashton 2073* (L).

Stemonoporus canaliculatis Auct., non Thw., Ashton in Fosberg & Dassanayake (eds.), Revised Handb. Fl. Ceylon 1(2): 189. 1977, p.p., quoad spec. Ashton 2073; reprint 1: 408. 1980; Kostermans, l.c.

Spindly tree of 10 m (?) and 3 cm dbh., coppicing at base and flopping over. Branchlets thick, angular, densely, very minutely brown puberulous; terminal bud small. Leaves coriaceous, oblong, 35–41 × 14.5–17 cm, shortly (up to 1 cm), abruptly acuminate, base rounded; above glabrous, glossy, the midrib and the thin lateral nerves prominulous in a shallow groove, reticulation obscure; below dull, midrib atout, strongly prominent, lateral nerves 20–25 pairs, patent, slightly curved, prominent, almost at the margin connected into a conspicuous marginal nerve, in between lateral nerves, ca. 1/3 the length of the lateral nerves; secondary nerves sub-parallel, slender, prominulous, reticulation dense, rather obscure. Petiole stout, densely puberulous, 5–7 cm long, the upper half often somewhat thicker than the lower half, not geniculate.

Fruit (detached) immature, subglobose, brown, scurvy; sepals thickish, carinate, ovate-oblong, acute, up to 7 mm long, clasping the base of the fruit (sub-erect).

DISTRIBUTION: Only known from the type locality.

NOTE: Ashton included this in *S. canaliculatus*, which has, however, entirely different leaves which are much smaller with much less lateral nerves, an impressed midrib on the upper surface and a different pattern of lateral nerves and reticulation. The single fruit in the specimen, which was available, was detached. Ashton on his label remarked that the tree was sporadically flowering and fruiting.

Ashton 2073, S.W. Ceylon, Nellowe-Pelawatte new road, gregarious on

low broad ridge in mixed Dipterocarp forest, 120 m, April, young fr. (K, L, PDA, US).

3. *Stemonoporus bullatus* Kosterm. — Fig. 36, 36a

in Liber gratulat. de Wit: 209, fig. 1. 1980; Bull. Museum nation Hist. natur. Paris, 4e Sér., Sect. *B. Adansonia* no. 3: 334, t. 2, 3. 1981. — Typus: *Balasubramaniam 2147* (G).

Stemonoporus canaliculatus Auct. (non Thw.), Ashton in Fosberg & Dassanayake (eds.), Revised Handb. Fl. Ceylon 1(2): 189. 1977, p.p., quoad *Ashton 2046* and *Meijer 545*; reprint 1: 408. 1980; Kostermans, l.c.

Small tree, up to 3.5 m high, bole 3–4 cm in diam. Bark smooth, grey. Apical part of branchlets, petioles of young leaves, small terminal bud with fugaceous minute indumentum, the same on inflorescence and outside of calyx, but here permanent. Leaves coriaceous, elliptic to subovate-elliptic, 20–35 × 7–12 cm, with abrupt slender, obtuse, 1–2 cm long acumen, base rounded; above glossy, bullate, midrib narrow, strongly impressed, lateral ribs and secondary nerves impressed; below glossy, paler, midrib strongly prominent, the 16–18 pairs of erect-patent lateral nerves prominent, at the margin arcuately connected into a conspicuous marginal vein; accessory lateral nerves horizontal, much shorter, straight; secondary nerves scalariform, perpendicular to the lateral nerves, starting where the accessory, horizontal veins stop; other reticulation of the same pattern, obscure, margin slightly incurved. Petiole 2–5 cm long.

Inflorescences glomerulate, axillary and extra-axillary, with one or few flowers; pedicel thick, 1–2 mm long, obconical, light red (fresh), at the base with tiny bracts, broader than long. Sepals lanceolate-oblong, acute, 5 mm long, light red (fresh). Petals oblong, obtuse, ca. 8 mm long, 4 mm diam., glabrous, white. Anthers 15, narrowly lanceolate, up to 5 mm long, tubular orifice 1–2 mm long, obscuring the style. Flowers erect and facing sideways. Fruit globose, up to 3.5 cm diam., slightly depressed, grey, roughish, thin-skinned. The persistent sepals not hardened, flat, adpressed to the base of the fruit.

DISTRIBUTION: S.W. Ceylon, wet, evergreen forest, Kanneliya forest near Hiniduma, also on Hinidumkande (Haycock), alt. 150– 800 m.

NOTE: By Ashton confused with *S. canaliculatus*. It has much larger leaves, with considerably more lateral nerves (16–18 pairs versus at most 11 pairs), a strongly bullate upper surface and narrower sepals, adpressed to the ripe fruit. The pale grey colour of the mature fruit is uncommon in *Stemonoporus* and so is the light red colour of pedicel and sepals. The cotyledons are pale green, strongly folded; after germination they are free from the pericarp, lifted above the ground by the lengthening hypocotyl, becoming horizontal, larger, wrinkled and darker green. The tree is often flopped over, because of its thin bole, quite different from the erect boles of *S. canaliculatus*.

S.W. Ceylon: *Balasubramaniam 2147*, Hiniduma Distr., Kanneliya forest, ca. 150 m, Jan., fl. (G, L); *Balasubramaniam s.n.*, old logging road, opposite bungalow, along river, ster. (G, L); *Kostermans 27642, ibid.*, May, fl.

(AARH, G, L); *Meijer 545, ibid.*, sapling of one m (PDA, US); *Kostermans 27654*, along main forest road, near main entrance, steep river slope, May, fl., fr. (AARH, G, L); *Ashton 2046*, steep hillside, ster. (PDA); *Bernardi 15477*, near Hiniduma, Mt. Kalubovitiangala, 888 m, on Dewalagama Rd., fl. (G, PDA).

4. *Stemonoporus kanneliyensis* Kosterm. — Fig. 37, 37a, 37b.

in Liber gratulat. de Wit: 213, fig. 2, 3. 1980; Bull. Museum nation Hist. natur. 4e Sér., Sect. *B. Adansonia* no. 3: 336, fig. 4. 1981. —- Typus: *Kostermans 24995* (L).

Stemonoporus reticulatus Auct. (non Thw.) Ashton in Fosberg & Dassanayake (eds.), Revised Handb. Fl. Ceylon 1(2): 192. 1977, except: *C.P. 3414* and *Ashton 2073*; reprint 1: 416. 1980; Kostermans, l.c.

Tree, up to 15 m tall and up to 35 cm dbh., flowering when only 4 m tall and 10 cm dbh.; bole up to 8 m long. Bark smooth, hard, grey, very superficially wavily, narrowly fissured, hoop-ringed, 1 mm thick. Live bark light brown, 4 mm thick. Wood white, rather hard. Terminal bud small, when developing forming a long bare shoot with the leaves apically, both obscurely densely very minutely puberulous, soon glabrous. Leaves glabrous, rigidly coriaceous, elliptic to subovate-elliptic, 11–23 × 5–8 cm, abruptly acuminate, acumen very slender, sharp, 1–2.5 cm long, base rounded or almost so; above (adult leaves) smooth, the midrib shallowly impressed; below glossy, paler, midrib strongly prominent, the 10–18 pairs of lateral rather patent lateral nerves slender, prominent, near the margin arcuate, in between (especially in the lower half of the lamina) conspicuous, almost horizontal, shorter intermediate lateral nerves; secondary nerves thin prominulous, towards the margin scalariformous, obliquely to the lateral nerves; reticulation lax. Petioles 3–7 mm long, often geniculate.

Racemes 3–7 cm long, or flower solitary, extra-axillary, often on old branches, few-flowered, densely, very minutely puberulous. Pedicels thickish, 3–4 mm long. Sepals 5, sometimes 6, lanceolate, acute, stiff, patent, 1 cm long, yellowish green inside, brown outside (fresh). Petals ovate, acute, patent, fleshy, yellow, somewhat longer than the sepals. Anthers 15, adpressed againts the silvery puberulous, pyramidal, ribbed ovary, shorter than the style, lanceolate, acute, the 10 outer ones longer than the inner 5, which are opposite the 5 outer ones; filaments very short.

Fruit conical, acute, thick-skinned, roughish rust brown, up to 4.5 cm high, and 4 cm diam. at the rounded base, distinctly, broadly 6-ribbed: the hardened, up to 1 cm long sepals pointing downward. At germination the pericarp splits into 3 valves (each valve 2-ribbed). The cotyledons remain in the fruit, when the seedling has already 4 normal (but smaller) leaves and the fruit is above the ground, lifted by the lengthening hypocotyledon.

Ashton 2073, which I was unable to place formerly, is here described as *S. marginalis*.

S.W. Ceylon: *Kostermans 24995*, Galle Prov., Hiniduma Distr., Kanneliya forest, 150 m, wet, evergreen, June, fl. (K, L, PDA, US); *Cramer 3071*, same tree (PDA, US); *Jayasuriya & Kostermans 2352*, same tree near Bungalow on river, July, fl. (PDA, US); *Kostermans 27653*, along main forest road, sapling (AARH, G); *Kostermans 27650, 27651, 27655, ibid.*, May, fl. (AARH, G, L);

Balasubramaniam 179, along river near Bungalow, ster. (PDA); *Meijer 540 & 900, ibid.*, ster. (PDA, US); *Ashton 2048, 2092, ibid.*, ster. (PDA).

5. *Stemonoporus revolutus* Trimen ex Hooker f. — Fig. 38

in Trimen & Hooker f., Handb. Fl. Ceylon 5: 384. 1900; Livera, Ann. Roy. Bot. Gard. Peradeniya 9: 98. 1924; Lewis, Veget. Prod. Ceylon: 48. 1934; Ashton in Fosberg & Dassanayake (eds.), Revised Handb. Fl. Ceylon 1(2): 193. 1977; reprint 1: 416. 1980; Kostermans in Liber gratulat. de Wit: 217. 1980; Bull. Museum nation. Hist. natur. Paris, 4e Sér., Sect. *B. Adansonia* no. 3: 338, fig. 5. 1981. —- Typus: *Lewis s.n.*, Jan. 1893, over-looking Kukul Korale, ridge 3000 ft., ster. (K).

Treelet, 4—5 m tall. Branchlets stout, angular, apical part glabrous or almost so. Terminal bud small. Leaves glabrous, stiffly coriaceous, elliptic to oblong, 3—11 × 1.5—5 cm, margin revolute, apex rounded, rarely slightly emarginate, base rounded, very rarely shortly subcuneate, above glossy, midrib thin, impressed, lateral nerves very thin, prominulous in a depression; below paler, midrib strongly prominent, the 7—14 pairs of rather patent to erect-patent slender lateral nerves prominent, near the margin strongly arcuate over a short distance, reticulation dense, obscure, the secondary nerves hardly or not differentiated from the reticulation. Petioles stout, 5—15 mm long, straight.

Inflorescences racemiform, axillary, slightly, sparsely minutely puberulous, main peduncle 1—3 cm long, bearing the apically agregate 1—5 flowers. Pedicels rather slender, up to 6 mm long. Sepals thin, oblong, acute, sparsely puberulous to glabrous, up to 6 mm, acute. Petals yellow, spathulate to ovate-oblong, obtuse, up to 6 mm long. Stamens 15.

Fruit globose, 3 cm diam., scabrous, brown, rather thin-skinned, sepals not enlarged, patent-recurved (angle of 45 degrees).

DISTRIBUTION: Only known from one ridge overlooking Sinharaja forest, rocky.

NOTE: As elucidated in my paper of the type specimen, as described by Hooker, is sterile and hence Hooker added a question mark to the genus. The type specimen, which is at Kew, where Hooker described it and not in Peradeniya, is the specimen of Lewis collected in the Kukul Korale, collected in Jan. 1893, an isotype is in Peradeniya. The flower bearing specimen was collected by Lewis in Dec. 1893 on Walankande.

Ashton overlooked the note on the type sheet of Lewis which reads: tree 15 ft. and is hence no canopy tree as he pretends. He overlooked furthermore a note, that the fruit was depicted in the collection of colour plates in Peradeniya.

The leaves are not strongly revolute, but only slightly at the margin. Ashton was misled by the badly dried sterile specimen of Lewis.

Ashton's remark, that the tree apparently flowers sporadically at all times, is not based on any fact; he saw only one flowering herbarium specimen.

Waas 1770, S. of Sinharaja forest, entrance from Deniyaya, 1300 m, June, fl. (PDA); *Lewis s.n.*, Walankande (Panilla). Dec. 1893, fl. (PDA); *Lewis s.n.*, steep rocky ridge, 100 m, overlooking Kukul Korale, Jan. 1893, ster (PDA,

K); *Livera s.n.*, Kiribatgala near Kahawatte, sapling (PDA), leaves up to 16 × 6 cm. not revolute; petiole up to 2.5 cm.

6. *Stemonoporus gracilis* Kosterm. — Fig. 39, 39a

Bull. Museum nation. Hist. natur. Paris, 4e Sér., Sect. *B: Adansonia* no. 3: 340, fig. 6. 1981. — Typus: *Ashton 2003* (G).

Stemonoporus lancifolius Auct. (non Alston), Ashton in Fosberg & Dassanayake (eds.), Revised Handb. Fl. Ceylon 1(2): 191. 1977, *p.p., quoad Ashton 2003 & Balakrishnan 343*; reprint 1: 413. 1980; Kostermans, l.c.

Tree, up to 4 m tall, glabrous in all its parts, stem up to 5 cm diam. Bark pale, smooth. Branches pendant. Branchlets slender, glabrous, terminal bud in rest-stage short, globose. Leaves chartaceous to sub-coriaceous, subovate-oblong, 7–15 × 2.5–5 cm, caudate-acuminate (acumen very slender, 1–3 cm long, obtuse), base rounded; above glossy, smooth, midrib deeply channeled, sometimes lateral nerves faintly visible, below paler, glossy, midrib strongly prominent, lateral nerves thin, prominulous, rather patent, towards the margin arcuate, 10–12 pairs, in between much shorter lateral veins, other veins forming a lax, obscure reticulation. Petiole thin, 1–3 cm long, slit-like channeled above.

Flowers solitary on thin, up to 2 cm long unbranched axillary peduncle, often microscopically adpressed pseudo-scaly. Pedicel thin, up to 8 mm long. Sepals narrowly oblong, rather fleshy, up to 12 mm long; petals yellow, ovate-oblong, acutish, slightly longer. Stamens 12–13 (two flowers dissected), narrowly triangular, acute, 5–6 mm long, ca. 1 mm wide at the base, 1–1.5 mm of the apical part a laterally slightly open tube. Ovary glabrous, sub-globose with long, slender style, slightly shorter than the stamens and insconspicuous stigma.

Fruit sub-globose, acutish, rather thin-skinned, 15 mm diam., outside divided into minute, polygonal fields. The persistent sepals not hardened, pointing downward. Fruit cracking irregularly at germination.

DISTRIBUTION: Only known from an area along a tributary of the Kelani R., ca. 0.5 mile S. of Kitulgalle.

NOTE: The shape (not the size) of the acumen, and reticulation resembles strongly that of *S. elegans*, but our species differs by the larger leaves, the larger number of stamens, the much broader sepals and the larger fruit.

It is rather remote from *S. lancifolius*, with which it has been confused by Ashton and from which, in sterile condition, it can be readily distinguished by the pinnately veined leaves (triplinerved in *S. lancifolius*) and the channeled midrib on the upper surface (midrib prominulous in *S. lancifolius*). The number of stamens, however, brings it nearer to *S. lancifolius*, then to *S. elegans*.

Bremer 940, Kegalle Distr., shore and forest along tributary of Kelani R., 0.5 mile S. of Kitulgalle, ca. 80° 24' E, 6°59' N, 70 m, wet, evergreen forest, March, fl., fr. (PDA, S, US); *Balakrishnan 343*, ibid., Aug., fl. (PDA); *Ashton 2003*, ibid., March. fl. (G, PDA, US); *Kostermans s.n., ibid.*, March. fl., fr. (L).

7. *Stemonoporus gardneri* Thwaites — Fig. 40, 40a

in Hooker's Kew J. Bot. 6: 69, tab. 2 A. 1854; Enum. Pl. Zeyl.: 38. 1858 and 403. 1864, as a synon. of *Vateria gardneri* Benth.; Beddome, Fl. sylv.: tab. 99. 1870; Pierre, Fl. for. Cochinch. 17: tab. 258 H. 1892; Heim, Bull. Soc. Bot. France 39: 153. 1892; Trimen, Handb. Fl. Ceylon 1: 133. 1893; Alston in id. 6 (Suppl.): 26. 1931, excl. Lewis s.n., Wallankande; Brandis, J. Linn. Soc. 31: 139. 1895; Lewis, Trees & fl. Pl. W. & Sabaragamuwa Prov.: 36. 1902; Veget. Prod. Ceylon: 145. 1934, quoad nomen tantum; Ashton in Fosberg & Dassanayake (eds.), Revised Handb. Fl. Ceylon 1(2): 190. 1977, excl. Lewis s.n., Wallankande; reprint 1: 412. 1980; Kostermans, Bull. Museum nation. Hist. natur. Paris, 4e Sér., Sect. *B. Adansonia* no. 3: 342, fig. 7. 1981; Nair & al., J. Econ. & Taxon. Bot. 3(3): 650. 1984. — Lectotypus propositum: *Gardner s.n., C.P. 1920, p.p.*, Adam's Peak (PDA).

Vateria gardneri (Thw.) Benth. ex Thw., Enum., l.c.: 403. 1864; Dyer in Hooker f., Pl. Brit. Ind. 1: 314. 1874; Trimen, Syst. Catal.: 9. 1885; Handb., l.c.; Kostermans, l.c.

Vatica gardneri (Thw.) A.DC., Prodr. 16(2): 622. 1868; Dyer, l.c.; Kostermans, l.c.

Tree, up to 20 m tall and 70 cm dbh. No buttresses. Bark smooth, grey, ca. 0.5—1 mm thick, hoop-ringed; live bark 5 mm, white. Crown rather open (in Adam's Peak specimens). Branchlets thick, angled, often sulcate, glabrous to sparsely, microscopically puberulous with large protruding leaf scars. Terminal bud small. Stipules carinate, thick, acute, caducous, up to 5 mm long. Leaves glabrous, sub-coriaceous to stiffly, thickly coriaceous, oblong-ovate to ovate, 7—15 × 4—8 cm, rather abruptly acuminate (acumen short to long and rather slender, 5—20 mm), base rounded or truncate or obscurely sub-cordate; above smooth (rarely obscurely densely reticulate), glossy, midrib slightly sunk in broad groove, lateral nerves very thin, slightly impressed; below the stout midrib strongly prominent, the 5—13 pairs of lateral nerves erect-patent, prominent, near the margin strongly ascendently arcuate, not connected at the margin, the lower 2 or 3 pairs often proximate and more patent (pseudo-quintuplinerved); secondary nerves slender, prominulous, scalariformous, sometimes hardly distinguishable from the dense reticulation. Petiole 6—40 (—60) mm long, rather slender to thickish, geniculate or straight, apical part slightly swollen.

Inflorescence with fugaceous, very minute puberulence, rather numerous, attached slightly above the axils of the apical leaves, either racemiformous or forming few and very shortly (apically) branched panicles, each with one to 7 flowers, up to 8 cm long. Buds before anthesis ovoid, pointed. Pedicel thickish, curved, 3—6 mm long or slender straight, 10—15 mm long. Sepals glabrous, greenish yellow to yellowish white (fresh), subovate-elliptic to broadly oblong, up to 8 × 5 mm, acutish, longitudinally veined. Petals pale lemon yellow, broadly ovate-elliptic, up to 6—8 mm long. Stamens 15,3 mm long, densely grey puberulous. Style 5 mm long, included in the cone of stamens.

Fruit globose (initially mucronate), rather thick-skinned, fielded-roughish, brown, up to 3.5 cm in diam., the persistent sepals not enlarged, stiff, pointing more or less downward. "Embryo thick, fleshy, lobed" (Brandis). Pericarp cracking irregularly at germination; cotyledons large, fleshy, lobed and wrinkled red.

DISTRIBUTION: S. and E. slopes of Adam's Peak, between 1500 and 1800 m altitude and in the higher areas of Sinharaja forest near Enselwatte.

NOTE: The leaves of the specimens enumerated here differ considerably in shape from pure ovate wih few (5–7 pairs) of lateral nerves to ovate-oblong with up to 13 pairs of lateral nerves, and in consistency, those of the Adam's Peak being very stiffly, rigidly coriaceous, those from Sinharaja sub-coriaceous. Also the petioles differ considerably in length and thickness, those from Adam's Peak being thickish, 6–40 mm long, those from Enselwatte up to 6 cm long, slender. The flowers of all specimens seem to be the same, but the pedicels are either thickish and curved (Adam's Peak) and up to 4 mm long, those from Enselwatte straight, slender, up to 15 mm long. Although the above are rather striking differences, I am not in the position with the scanty material available, to separate them in entities.

Dyer and Ashton called the inflorescences paniculate, Trimen and De Candolle racemiformous. Actually both are represented, racemes being actually pseudo-racemes, reduced panicles. That they are not exactly axillary, has been nowhere mentioned.

I have not seen specimens below 1500 m alt. on Adam's Peak, those on Enselwatte are from 1000 m alt.

Lewis's *S. gardneri* was based on a specimen from Wallankande, which Trimen identified as *S. gardneri*. Ashton made the same mistake. It is quite different and here enumerated under *S. scalarinervis*.

Ashton (l.c.: 190) erroneously quoted Beddome's plate as *Vateria gardneri*; it is *Stemonoporus gardneri*.

The note in Lewis, Veget. Prod., l.c., that it is found near Badulla is misplaced and belongs under the foregoing *S. acuminatus*.

Ashton 2109, Adam's Peak, S. slopes, common between 1200 and 1600 m, ster. (PDA), labelled as 20 m tall and 70 cm dbh.; *Kostermans 27018*, above Moray Estate, Maskeliya Distr., canopy tree with *Palaquium rubiginosum*, Nov., young fr. (G, L, PDA); *Kostermans 27234, ibid.*, Jan., young fr. (G, L, PDA); *Ashton 2110, ibid.*, April, mature fr. (K, L, P, PDA, US); *Sohmer & Waas 8687, ibid.*, Dec., young fr. (PDA); *Ashton 2912, ibid.*, Apr., after anthesis (K, L, P, PDA, US), quoted as 2112; *Bernardi 15788*, from Carney to Adam's Peak, Dec., buds. (G, PDA); *Thwaites C.P. 1920*, Gongals near Adam's Peak, March 1852, fl. (PDA); *Trimen s.n.*, Maskeliya, March, buds (PDA); *Gardner s.n., C.P. 1920*, Adam's Peak, fl. (PDA), type; *Sohmer & Waas 10435, 10460*; Sinharaja forest, N. Enselwatte, along Madaelle stream, 1000 m, entry Army Camp, Nov., after anthesis (PDA); *Waas 1479, ibid.*, Febr., young fr. (PDA); *Huber 613, ibid.*, Nov., after anthesis (PDA).

8. *Stemonoporus canaliculatus* Thwaites. — Fig. 41

Enum. Pl. Zeyl.: 38. 1858 and 403. 1864, as a synon. of *Vateria canaliculata* Benth.; A.DC., Prodr. 16(2): 621. 1868, as a synon. of *Vatica canaliculata*; Dyer in Hooker f., Fl. Brit. Ind. 1: 315. 1874, as a synon. of *Vateria canaliculata*; Trimen, Handb. Fl. Ceylon 1: 135. 1893; Brandis, J. Linn. Soc. 31: 140. 1895; Lewis, Veget. Prodr. Ceylon: 47. 1934; Ashton in Fosberg & Dassanayake (eds.), Revised Handb. Fl. Ceylon 1(2): 192. 1977, *pro minime parte*, only C.P. 3413; reprint 1: 408. 1980; Kostermans in Liber gratulat. de Wit: 216. 1980; Bull. Museum nation. Hist. natur. Paris, 4e Sér., Sect. *B. Adansonia* no. 3: 346, fig. 8. 1981; Nair & al., J. Econ. & Taxon. Bot. 3(3):

650. 1984. — Lectotypus propositum: C.P. 3413, Hinidoon Korle (= Hiniduma Korale), April 1855, fl., excl. detached fruit (PDA).

Vateria canaliculata (Thw.) Benth. ex Thw., Enum., l.c.: 403. 1864; Dyer, l.c.; Trimen, System. catal.: 10. 1885; Handb., l.c. (as *Stemonoporus canaliculata*); Ashton, l.c.; Kostermans, l.c.

Vatica canaliculata (Thw.) A.DC., Prodr. 16(2): 621. 1868; Dyer, l.c.; Kostermans, l.c.

Tree, up to 5 m tall and dbh. 10 cm. Bark smooth, grey, hoop-ringed. Branchlets patent, terminal part sub-angular, rather thin, densely microscopically brown puberulous. Terminal bud small with similar indumentum. Leaves thinly coriaceous, rather stiff, elliptic to lanceolate, 6–15 × 2–6 cm, rather broadly, obtusely acuminate (acumen 6–12 mm long), base obtuse or shortly acutish; above glossy, glabrous, sub-bullate, midrib slender, deeply impressed, lateral nerves thin, impressed, sometimes secondary impressed veins visible; below paler, initially midrib and lateral nerves microscopically puberulous, midrib strongly prominent, lateral nerves prominent, erect-patent, 9–12 pairs, some of them at 1–2 cm from the margin arcuately connected, secondary nerves scalariformous, slender, prominent; reticulation none or obscure. Petiole slender, densely puberulous, 1–4 cm long, straight or geniculate.

Inflorescence consisting of 1–2 axillary or usually extra-axillary sessile flowers on an inconspicuous, up to 2 mm long, thick, puberulous peduncle; at the flower base a number of minute, ovate, acute bracts. Sepals ovate-oblong, acute, 5–6 mm long, densely puberulous outside. Petals thinner, ovate, obtuse, 7 mm long. Stamens 15, puberulous. Fruit greyish brown, depressed globose, up to 3.5 cm diam. and 2.5–3 cm high with thin pericarp and folded, dark red cotyledons, pericarp roughish, brown, divided into polygonal areas. Sepals not hardened, pointed downwards. "Cotyledons thick, fleshy, both bifid to the base; the cells filled with starch. At the base of the fruit, the inner surface of the pericarp is lined by a flat membranous cup, the rim of which is divided into 10 linear laciniate, upright lobes, which penetrate in between the lobes of the cotyledons" (Brandis). The pericarp cracks irregularly at germination. The cotyledons are fleshy, red, lobed and wrinkled, spreading. The thick radicle has below its tip a collar of thin, adpressed, silky hairs.

DISTRIBUTION: S. W. Ceylon. Hiniduma and Sinharaja, lowland to 1200 m alt., very wet, evergreen forest.

NOTE: Related to *S. bullatus*, but the leaves much smaller and slightly puberulous underneath, the flowers sessile and smaller, the number of lateral nerves much less.

The type specimen (PDA) has a detached fruit attached to the sheet, which belongs to *S. bullatus*. It has the pubescent sepals closely adpressed to the fruit, whereas in *S. canaliculatus* they are free from the fruit and pointing downward.

C.P. 3413, S.W. Ceylon, Galle Distr., Hiniduma, near Nellowe, April 1855, fl. (PDA, 3 sheets); *C.P. 3413*, Reigam Korale, Sept. 1856, fr. (PDA); Kostermans s.n., Sinharaja forest, S.W. Ceylon, Weddegale entrance, S. part, July, ster. (L); Kostermans 27876, ibid., Oct., fr. (AARH, G, L, PDA);

Gunatilleke s.n., ibid., ster. (PDA); Waas 1754, Deniyaya entrance, 1200 m, June, fl. (PDA, no flowers present because of bad curating); Kostermans 28112, March, fr. (G, L).

9. *Stemonoporus nitidus* Thwaites — Fig. 42

Enum. Pl. Zeyl.: 39. 1858 and 403. 1864, as a synon. of *Vateria nitida* Benth.; Trimen, Handb. Fl. Ceylon 1: 136. 1893, excl. var. *lancifolia* ; ibid. 5: 383. 1900; Brandis, J. Linn. Soc. 31: 141. 1895; Lewis, Veget. Prod. Ceylon: 48. 1934; Ashton in Fosberg & Dassanayake (eds.), Revised Handb. Fl. Ceylon 1(2): 191. 1977; reprint 1: 414. 1980; Kostermans, Bull. Museum nation. Hist. natur. Paris, 4e Sér., Sect. *B. Adansonia* no. 3: 348. 1981. — Typus: *C.P. 3483*, Pasdoon Korle (Pasdun Korale) at no great elevation, fl. (K?).

Vateria nitida (Thw.) Benth. ex Thw., Enum., l.c.: 403. 1864; Dyer in Hooker f., Fl. Brit. Ind. 1: 316. 1874, excl. var. *lancifolia*; Trimen, System. Catal.: 10. 1885; Handb., l.c. (as a synon. of *Stemonoporus nitidus*); Ashton, l.c.

Vatica nitida (Thw.) A.DC., Prodr. 16(2): 622. 1868; Dyer, l.c.

Stemonoporus lucidus Thw., mss. in Herb. Hooker ex Thwaites, Enum., l.c.: 39.

Doona nitida (Thw.) Heim, Recherches Diptéroc.: 72. 1892; Bull. Soc. Bot. France 39: 153. 1892; Brandis, l.c.; Trimen, l.c., 5: 383. 1900.

Small tree. Branchlets slender, glabrous. Terminal bud small, glabrous. Leaves chartaceous to sub-coriaceous, ovate to ovate-lanceolate, 6—9 × 2—3.5 cm, caudate-acuminate (acumen 5—15 mm long, slender, obtuse), base rounded to sub-cuneate; above glossy, midrib slender, prominulous, lateral nerves very thin, faint, reticulation obscure, below glossy, paler, midrib slender, prominent, lateral nerves 4—6 pairs, very thin, erect-patent, arcuate, near the margin strongly arcuately ascendent but not connected, prominulous; in between the lateral veins sometimes more patent, obscure, 1 to 3 shorter ones; reticulation usually distinct; no parallel secondary nerves. Petiole thin, not thickened, 5—10 mm long.

Axillary very short, glabrous peduncles bear one flower on a 2 mm long, rather slender pedicel. Sepals ovate, acute, glabrous. Petals yellowish, elliptic, acute. Anthers 15, puberulous.

"Fruit nearly globular, ca. 18 mm diam., calyx lobes 7.5 mm, oblong, 12 mm long" (Trimen).

DISTRIBUTION: Pasdun Korale, S.W. Ceylon, low, wet, evergreen.

NOTE: Only known from one collection, which in Peradeniya has one immature flower. The fruit are described by Trimen, but no fruit is available in Peradeniya. De Candolle described a young fruit.

It is not clear, where the holotype is, as Thwaites mentions Pasdoon Corle, and the Peradeniya material is marked Hinidoon Corle, Sept. 1855. Thwaites mentiones a specimen in herbarium Hooker (K) which he has named *S. lucidus*. This might be the holotype.

The species resembles in reticulation somewhat *S. reticulatus*, but the latter is completely different in all other respects.

I have not seen Worthington's specimens, quoted by Ashton. Ashton says, that it is a tree up to 40 m, which I strongly doubt; he described the leaves as

lanceolate, which is certainly wrong, neither is the base cuneate and the petiole is not geniculate.

C.P. 3483, Hinidoon Corle (hiniduma Korale), Sept. 1855, fl. (PDA).

10. *Stemonoporus laevifolius* Kosterm. — Fig. 43

Bull. Museum nation. Hist. natur. Paris, 4e Sér., Sect. *B. Adansonia* no. 3: 350, fig. 9. 1981. — Typus: *Waas 2864* (L).

Stemonoporus acuminatus, forma b Trimen, Handb. Fl. Ceylon 1: 134. 1893 (*C.P. 3595*, PDA, 2 sheets; not the sheet marked Badulla, originally *C.P. 3474*, later 3595); Ashton in Fosberg & Dassanayake (eds.), Revised Handb. Fl. Ceylon 1(2): 189. 1977 (*C.P. 3595*, PDA and *Ashton 2125 & 2126*, PDA); reprint 1: 406. 1980.

Vateria acuminata (non Hayne), Thw., Enum. Fl. Zeyl.: 403. 1864, p.p., quoad *C.P. 3595* (PDA, excl. the sheet, marked Badulla, originally *C.P. 3474*, later 3595).

Tree, 4 m tall, dbh. 15 cm. Branchlets slender, glabrous, smooth. Terminal bud small. Stipules narrow, 1 mm long, caducous. Leaves glabrous, subcoriaceous, lanceolate, 8—14 × 2.5—4 (—4.5) cm (sapling: 24 × 6 cm), conspicuously, but not abruptly acuminate (acumen slender, with broad base, 1—2.5 cm long), base rounded to sub-truncate, margin at base below sub-revolute; above smooth to obscurely minutely reticulate, midrib prominulous, sometimes the thin lateral nerves visible; below glossy, densely, minutely smoothly, rather obscurely reticulate, midrib prominent, lateral nerves 12—16 pairs, rather patent, rather obscure, very thin, near the margin over a short strech arcuate; no secondary nerves. Petiole thin, 1.5—3.5 cm long, apical part somewhat thickened.

Inflorescence axillary, 1—2-flowered on an up to 2 mm long main glabrous peduncle. Pedicel thickish, 5 mm. Sepals rather narrowly ovate-oblong, glabrous, acutish, up to 10 mm long. Petals yellow, elliptic, acutish, longer than the sepals, rather fleshy. Stamens 15. Young fruit slightly sulcate, the not enlarged tepals pointing downward. Cotyledons after germination expanded, large, fleshy, wrinkled, incised.

DISTRIBUTION: Ambagamuwa Prov., Kurulagala (Rakwana), Yakinadola (Sinharaja).

NOTE: The species has been recognized as forma b by Trimen, which was confirmed by Ashton. The latter thought, that C.P. 3595 was a mixture of *Stemonoporus acuminatus* and *Vatica obscura*. I disagree, the two sheets in Peradeniya are both *Stemonoporus*, the similarity with *Vatica obscura* leaves is really striking, but *Vatica* can always be differentiated from *Stemonoporus* (in Ceylon), by having stellate hairs on the youngest parts, in *Stemonoporus* there are always simple hairs and hence *C.P. 3595* is not a mixture, but all *Stemonoporus*. The sheet 3595, marked Badulla in Peradeniya is quoted by Trimen as *J. Bailey C.P. 3474*.

The number of lateral nerves in the sapling specimen does not differ from that of the grown up tree, contrarily to Ashton's statement.

Ashton's discussion on the site of Medamahanuwara is entirely wrong.

Medamahanuwara is in between Urugala and Hunasgiriya and Alutnuwara is at the other side of the Mahaweli Gange of Mahiyangane (Ashton's interpretation of the locality is wrong: it should be read as: Alutnuwara-at-the-Mahaweli, to distinguish it from other Alutnuwara's = New Towns). The locality is simply on the Kandy-Madugoda-Mahiyangane road and there are some wet areas, near Medamahanuwara, at the Kandy side of Madugoda where this might have occurred).

The species is close to *S. reticulatus*, the latter has broader leaves and less lateral nerves. It is only remotely akin to *S. acuminatus* which has very distinct, less numerous lateral nerves with distinct scalariform secondary nerves, moreover these lateral nerves are more patent and only slightly arcuate near the margin. The glabrous sepals are another difference.

S.W. Ceylon: *Waas 2064*, Yakinodole-Sinharaja, Ratnapura Distr., 200 m, Febr., fl. (L, PDA); *C.P. 3595*. Medamahanuwara between Urugala and Hunasgiriya, road Kandy to Mahiyangane, May 1855 and May 1866, young fr. (PDA, 2 sheets, one from the Knuckles: between Medamehanuwara and Alutnuwara, the other sheet a sapling branch and one seedling with expanded cotyledons, locality not indicated); *Ashton 2125*, Kurulagala, Rakwana, Apr., fl. (PDA); *Ashton 2126, ibid.*, sapling (PDA).

11. *Stemonoporus reticulatus* Thwaites — Fig. 44, 44a, 44b

Enum. Pl. Zeyl.: 38. 1858; Dyer in Hooker f., Fl. Brit. Ind. 1: 316. 1874; Trimen, Handb. Fl. Ceylon 1: 136. 1893, excl. var. *lancifolia*; ibid. 5: 383. Brandis, J. Linn. Soc. 31: 141. 1895; Lewis, Veget. Prod. Ceylon: 48. 1934; Ashton in Fosberg & Dassanayake (eds.), Revised Handb. Fl. Ceylon 1(2): 192. 1977, *pro minime parte*, only *C.P. 3414*, the rest excluded; reprint 1: 416. 1980; Maury, Thesis 2: 42, fig. 42; 115, fig. 244; 54, fig. 112 & 113. 1978; Kostermans in Liber gratulat. de Wit: 216. 1980; Bull. Museum nation. Hist. natur. Paris, 4e Sér., Sect. *B. Adansonia* no. 3: 352, fig. 10. 1981; Nair & al., J. Econ. & Taxon. Bot. 3(3): 650. 1984. — *Lectotypus propositum: C.P. 3414*, Hinidoon Corle (Hiniduma Korale), fl., April 1855 (PDA).

Vateria reticulata (Thw.) Benth. ex Thw., Enum., l.c.: 403. 1864; Dyer, l.c.; Trimen, System. Catal.:10. 1885; Handb., l.c. (as synon. of *Stemonoporus reticulatus*); Ashton, ll.cc.; Kostermans, l.c. 352.

Vatica reticulata (Thw.) A.DC., Prodr. 16(2): 620. 1868; Dyer, l.c.; Kostermans, l.c. 352.

Kunckelia reticulata (Thw.) Heim, Recherches Diptéroc.: 92. 1892, combination not printed, and in Bull. Soc. Bot. France 39: 153. 1892; Brandis, l.c.; Kostermans, l.c. 352.

Tree, up to 20 m tall, bole 8 m, dbh. 20 cm. Bark light brown to grey, smooth, hoop-ringed. Branchlets rather slender, apically densely, microscopically puberulous, glabrescent. Terminal bud small. Leaves rigidly coriaceous, glabrous, subovate-elliptic to elliptic, 6–15 × 3–5 cm, conspicuously acuminate (acumen slender, obtuse, 6–20 mm long), base rounded to shortly acute; above glossy, smooth, the very thin midrib prominulous, the lateral nerves faint; below glossy, densely, smoothly reticulate (nervules flattened), midrib prominent, in very young leaves sparsely microscopically puberulous, lateral nerves 10–11 pairs, very thin, prominulous, erect-patent, very close to the margin abruptly, arcuately ascendent, not connected into a marginal vein,

secondary nerves absent or not different from the reticulation. Petiole slender, geniculate or not, upper part slightly thickened, 1.5–6 cm long.

Panicles (pseudo-racemes) axillary, consisting of a 5–15 mm long, slender, puberulous main peduncle, bearing (usually apically) 1–4 flowers on very short lateral branches. Pedicels thickish, puberulous, 2 mm. Buds slender, long and sharply pointed. Sepals thickish, glabrous, ovate-oblong to lanceolate, acutish, 6–8 mm. Petals yellowish (fresh), ovate, 1 cm long. Stamens 15.

Fruit ovoid, acute, its base flattened, pericarp thick, superficially, longitudinally grooved, the ribs very broad, slightly pointed, rusty scabrous, up to 3.5 cm diam., the not enlarged sepals stiff, pointing downward. A fibrous mass between the cotyledons (Heim). At germination opening by thick valves.

DISTRIBUTION: S.W. Ceylon, wet, evergreen lowland forest, alt. 300 m, near Nelluwe (Hiniduma Province) and S. Sinharaja.

NOTE: Ashton mixed this with at least two other, quite distinct species. This is one of the 3 species of *Stemonoporus* with a reticulation, exactly like that of the 3 Ceylonese species of *Vatica*.

There are 3 sheets in Peradeniya: one marked in pencil April 1855, near Nellowe, which has a fruiting branch, a flowering one and a sterile large-leaved one; the second one has 2 flowering branches and the pencilled note: near Nellowe, Hinidoon Corle, fr. Apr. 1855, fl. Sept. 1860 and the third has 2 flowering branches and is marked: near Nellowe, Sept. 1860.

Heim establised *Kunckelia* on account of the fruit, the thick pericarp and the planconvex, unequal cotyledons.

The species has been found again in Sinharaja forest where one tree is marked for observation.

S.W. Ceylon: *C.P. 3414*, Hiniduma Korale, Nellowe, April 1855, fl. (PDA, 2 sheets), type: *C.P. 3414, ibid.*, Sept. 1860, fr. (PDA, part of one sheet); *Gunatilleke B. 741*, Sinharaja forest Weddegala entrance, ster. (PDA); *Kostermans 27840*, same tree, Oct., buds (AARH, G, L, PDA); *Kostermans 27898*, same tree, Nov., fl. (AARH, G, L, PDA).

12. *Stemonoporus rigidus* Thwaites — Fig. 45, 45a

in Hooker's Kew J. Bot. 6: 69. 1854; Enum. Pl. Zeyl. 38. 1858 and 403. 1864, as a synon. of *Vateria rigida* Benth.; Trimen, Handb. Fl. Ceylon 1: 134, tab. 15, fig. 6–11. 1893; Pierre, Fl. for. Cochinch., fasc. 17: tab. 258 J. 1892; Heim, Recherches Diptéroc.: 89. 1892 and in Bull. Soc. Bot. France 39: 193. 1892; Brandis, J. Linn. Soc. 31: 140. 1895; Lewis, Veget. Prod. Ceylon: 46. 1934; Ashton in Fosberg & Dassanayake (eds.), Revised Handb. Fl. Ceylon 1(2): 193. 1977; reprint 1: 417. 1980; Kostermans, Bull. Museum nation. Hist. natur. Paris, 4e Sér., Sect. *B. Adansonia* no. 3: 353, fig. 11, 12. 1981 and p. 357; Nair & al., J. Econ. & Taxon. Bot. 3(3): 650. 1984. — Lectotypus propositum: *Thwaites, C.P. 2645*, Ambagamuwa, 1000 m, Dec. 1852, young fl. (PDA).

Vateria rigida (Thw.) Benth. ex Thw., Enum., l.c.: 403. 1864; Dyer in Hooker f., Fl. Brit. Ind. 1: 315. 1874; Trimen, System. Catal.: 10. 1885;

Handb., l.c. (as a synon. of *Stemonoporus rigidus*); Ashton, l.c.; Kostermans, l.c.

Vatica rigida (Thw.) A.DC., Prodr. 16 (2): 621. 1868; Dyer, l.c.; Kostermans, l.c.

Tree 12 m, dbh. 25 cm. Bark greyish black, smooth. The very young, thick, angled branches and the small terminal bud sparsely densely pulverulently, minutely puberulous, soon glabrous. Leaves extremely stiff, thickly coriaceous, elliptic to narrowly elliptic to more rarely subobovate-elliptic, 6–14 × 2.5–5 cm, obtuse or shallowly emarginate, base rounded to cuneately rounded; above glossy, sub-bullate, glabrous, the midrib very thin, prominulous in a deep depression, lateral nerves impressed, sometimes the impressed secondary nerves visible; below glossy, very sparsely, microscopically pilose, soon glabrous, midrib stoutly prominent; lateral nerves 8–11 (average 10) pairs, strongly prominent, erect-patent, slightly curved and near the margin strongly curved only over a short distance; secondary nerves thin, prominulous, numerous, parallel, no reticulation visible. Petiole rather thick, 1–2 cm long, hardly thickened apically, usually straight.

Inflorescence usually axillary, densely, minutely puberulous, consisting of one or two congested, very short (5 mm), thick racemes, bearing apically 1–3 flowers. Pedicels (immature) short, thick. Sepals densely, microscopically grey puberulous, thick, ovate, acute, carinate, up to 6 mm long. Petals (immature) about twice as long, thickish. Stamens 15. Fruit globose, brown, 3 cm diam.

DISTRIBUTION: Twice collected in 1852 and 1860 in Ambagamuwa, at 1000 m alt. which encompasses Adam's Peak jungle and part of Sinharaja. From the habit of the plant it might be a species growing on rocky places.

Recently rediscovered by Prof. Balasubramaniam of the Peradeniya University, several hundred trees growing on the southern slopes of the Peak Wilderness, between 1600 and 1800 m altitude, forming the main canopy tree together with *Garcinia echinocarpa*, Febr. 1981, fl., fr. Balasubramaniam 2583 (PDA), along trail from Gartmore Estate to Gapugastenne (Rayhdande Division), about 2 miles from Gartmore.

NOTE: De Candolle erroneously described the leaves as puberulous on both sides. The microscopical, stiff, thickish, straight hairs on the lower leaf surface disappear very quickly.

Tree 12 m, dbh. 25 cm. From comparison with other species and considering Thwaites terminology, it might be about 15 m high.

This is a poorly known species, formaly known from two collections only, one in Dec. 1852 (C.P. 2645) in young flower, which I designate as the lectotypus. It is accompanied by a shoot of what I think might be a seedling (not a sapling as Ashton says) with quite aberrant leaves (oblong, tapered both ends, obscurely shortly, broadly, bluntly acuminate, 8–14 × 2–3 cm); the other collection is marked as Ambagamuwa 1860 (PDA) and equally is a shoot with young flowers.

Whether Ashton's assumption (based on no facts) that it occurred in mid mountain forests, N. of Maskeliya, is a good or bad guess.

What Ashton means by connate (cuneate?) base and retuse acumen, of the leaves is not clear.

Thwaites C.P. 2645, Ambagamuwa, 1000 m, Dec. 1852, young flowers (PDA); *Thwaites C.P. 2645, ibid.*, Dec. 1860, young flowers (PDA); Southern slopes of the Peak Wilderness between 1600–1800 m altitude, forming the main canopy species, together with *Garcinia echinocarpa*, Febr., fl., fr., Balasubramaniam 2583 (PDA).

13. *Stemonoporus oblongifolius* Thwaites — Fig. 46

in Hooker's Kew J. Bot. 6: 68. 1854; Enum. Pl. Zeyl.: 38. 1858 and 403. 1864, as a synon. of *Vateria oblongifolia* Benth.; Trimen, Handb. Fl. Ceylon 1: 135. 1893; Pierre, Fl. for. Cochinch. fasc. 17: tab. 258 I. 1892; Brandis, J. Linn. Soc. 31: 141. 1895; Ashton in Fosberg & Dassanayake (eds.), Revised Handb. Fl. Ceylon 1(2): 192. 1977; reprint 1: 414. 1980; Maury, Thesis 2: 42, fig. 41: 54, fig. 111; 115, fig. 245; fig. 478 (hairs). 1978; Kostermans, Bull. Museum nation. Hist. natur. Paris, 4e Sér., Sect. *B. Adansonia* no. 3: 356, fig. 13. 1981; Nair & al., J. Econ. & Taxon. Bot. 3(3): 650. 1984. — Lectotypus propositum: *Thwaites C.P. 2646, p.p.*, Ambagamuwa, Dec. 1852, buds (PDA).

Vateria oblongifolia (Thw.) Benth. ex Thw., Enum., l.c.: 403. 1864; Dyer in Hooker f., Fl. Brit. Ind. 1: 315. 1874; Trimen, System Catal.: 10. 1885; Handb., l.c. (as a synon. of *Stemonoporus oblongifolius*); Ashton, l.c.; Kostermans, l.c.

Vatica oblonga A.DC., Prodr. 16(2): 621. 1868; Dyer, l.c.

Vesquella oblongifolia (Thw.) Heim, Recherches Diptéroc.: 90. 1892, combination not printed, and in Bull. Soc. Bot. France 39: 153. 1892.

Tree, up to 20 m tall and 40 cm dbh., not buttressed. Bark smooth, white, hoop-ringed, 1 mm thick. Live bark 3–6 mm thick, whitish, outside green. Wood yellowish, moderately hard, slightly resinous (resin dries white). Branchlets usually thick, angled, initially densely microscopically rusty puberulous. Terminal buds small, stipules not seen. Leaves rigidly coriaceous, glabrous (indumentum often subpersistent on midrib below), oblong to elliptic, rarely suboblanceolate oblong, 5–13 × 2.5–5 cm, usually rounded or obscurely broadly very shortly, obtusely acuminate, base shortly cuneate, rarely rounded; above rather dull, in mature leaves smooth, in younger ones obscurely veined and reticulate; midrib thin, prominulous, or so in shallow depression, lateral nerves faint, prominulous, below paler, midrib prominent, the 7–10 pairs of erect-patent or slightly more erect slender lateral nerves prominent, near the margin strongly, arcuately ascendent (but not connected), connected by usually conspicuous, numerous, very slender, parallel secondary nerves with minute reticulation in between. Petiole 1–2 cm long, straight or geniculate, apical part concave above.

Inflorescences puberulous, axillary and extra-axillary, stout, up to 4 cm long, bearing up to 5 flowers on obscure branches (pseudo-racemes). Pedicels stout, densely grey puberulous, 2–3 mm long, subtended by a small, ovate, acute bract. Sepals thin, ovate-elliptic, acute, densely puberulous outside, up to 8 × 5 mm. Petals light yellow (fresh), orbicular to broadly obovate or elliptic, up to 8 mm long, obtuse. Stamens 15, the anthers densely puberulous. Style hardly exsert from the stamens.

Fruit almost globose, rather thick-skinned, rusty verruculous, up to 2–3 cm in diam., only in young stages grooved. Sepals persistent, stiff, not enlarged, pointing downward. Cotyledons small.

DISTRIBUTION: S. slopes of Adam's Peak, from 1300–1700 m, *locally* not uncommon.

NOTE: Related to *S. gardneri* with similar fruit, but with a much more pronounced pubescence, especially on the sepals and much shorter pedicels.

The leaves — of course — have different shape, but a similar stiffly coriaceous texture. It seems to occupy the same distributional area, but has not been found so far in the adjacent higher zones of the Sinharaja forest.

This and *S. acuminatus* were considered to represent a different genus (*Vesquella*) by Heim, because of the chalaza cup or fibrous chalaza expansions in the fruit, the thin, sub-membraneous cotyledons and the abundant endosperm. I had no adequate material to check this.

Jayasuriya & Sumithraarachchi 1572, 1574, Adam's Peak above Moray Estate, Maskeliya Distr., 1600 m, dropped fr. (PDA); *1561, ibid.*, 1500 m, unripe fr. (PDA); *Kostermans 24787, ibid.*, May, fl. (L, PDA); *Kostermans 24933, ibid.*, June, fl. (L, PDA); *Kostermans 24259, ibid.*, 1300 m, May, fl. (L, PDA); *Kostermans 27051, ibid.*, Nov., young fr. (G, L, PDA); *Kostermans 24155, 24178, ibid.*, May, young fr. (L, PDA); *Kostermans s.n., ibid.*, May, fl., fallen ripe fr. (L); *Kostermans 27960, ibid.*, Nov., after anthesis (AARH, G, L, PDA); *Ashton 2007*, pilgrims trail from Laxapana, Maskeliya, 1600 m, March, fr. (PDA); *Ashton 2911 (2111), ibid.*, ster. (PDA); *C.P. 2646*, Ambagamuwa, Dec. 1852, buds (PDA, in convolute young fr.); *C.P. 2646*, Centr. Prov., May 1866, fl. (PDA); *sine coll., s.n., C.P. 2646*, sapling, leaves up to 16 × 6 and 15 × 7.5 cm (PDA).

14. *Stemonoporus petiolaris* Thwaites — Fig. 47, 47a

Enum. Pl. Zeyl.: 38. 1858 and 403. 1864, as a synon. of *Vateria petiolaris* Benth.; Trimen, Handb. Fl. Ceylon 1: 135. 1893; Brandis, J. Linn. Soc. 31: 141. 1895; Lewis, Veget. Prod. Ceylon: 47. 1934, *quoad nomen tantum*; Alston in Trimen, l.c. 6 (Suppl.): 26. 1931, *quoad nomen tantum*; Ashton in Fosberg & Dassanayake (eds.), Revised Handb. Fl. Ceylon 1(2): 192. 1977, *pro minime parte, quoad C.P. 3151 tantum, caet. excl.*; reprint 1: 415. 1980; Kostermans, Bull. Museum nation. Hist. natur. Paris, 4e Sér., Sect. *B. Adansonia* no. 4: 373, fig. 14. 1981; Nair & al., J. Econ. & Taxon. Bot. 3(3): 650. 1984. — Typus: *C.P. 3151*, Kitulgalle, May 1853 and 1854, fl. (PDA, 2 sheets).

Vateria petiolaris (Thw.) Benth. ex Thw., Enum, l.c.: 403. 1864; Dyer in Hooker f., Fl. Brit. Ind. 1: 315. 1874; Trimen, System. Catal.: 10. 1885; Handb., l.c. (as a synon. of *Stemonoporus petiolaris*); Ashton, l.c.; Kostermans, l.c.

Vatica petiolaris (Thw.) A.DC., Prodr. 16(2): 621. 1868; Dyer, l.c.; Kostermans, l.c.

Tree 10 m, dbh. 25 cm. Bark smooth, grey, thin, hoop-ringed. Live bark brown. Branchlets slender, glabrous or apically with a sparse indumentum of microscopical hairs. Terminal bud small. Leaves chartaceous, oblong, (10–)14–25 × (3–) 3.5–6.5 cm, abruptly acuminate (acumen rather slender, with parallel margins, obtuse, up to 2 cm long), base rarely subcuneate; above rather dull, smooth, glabrous or the secondary nerves and lateral nerves faint, impressed, midrib thin, prominulous, below more glossy, paler, very rough

(cystolithes), glabrous, except a sparse, powdery microscopic indumentum on the main nerves, midrib prominent, lateral nerves (10–)13–15 pairs, slender,, prominent, erect-patent, near margin rather abruptly arcuately ascendent (not connected), secondary nerves at right angles to midrib, slender, prominulous, towards margin perpendicular to the lateral nerves, in between an obscure reticulation. Petioles slender, straight, 2–7.5 cm long, apical part slightly thickened and with sparse pulverulent indumentum in young leaves.

Inflorescences axillary and extra-axillary on very short (2– 5 mm long) thick, minutely puberulous peduncles, bearing 1–4 flowers in axils of awl-shaped tiny bracts. Pedicels thickish, puberulous, 2 mm long. Sepals ovate, acutish, thickish, up to 7 mm long, outside densely sericeous puberulous. Petals white, obovate-subspathulate, up to 1 cm long obtuse, longitudinally veined. Stamens 10, minutely puberulous. Fruit globose, smooth.

DISTRIBUTION: Kitulgalle area.

NOTE: The material (apart from the *C.P. 3151*) enumerated by Ashton, does not belong here; it differs by thicker leaves with closely packed numerous secondary nerves and different much longer hairs.

Alston mentioned a Lewis specimen from the same area, S.W. Ceylon with a fruit. I have not seen this but I suspect it to be *S. scalarinervis*.

Lewis's description contains contradictions: he states that the tree is 20 feet high, but in the discussion of the timber, that it attains considerable size. A tree of 20 feet. is hardly a timber tree. Apparently he confused it with another species. He mentioned Gongalle Range (repeated by Alston).

The species was only known from the type locality by a single collection. In April 1980 I rediscovered two trees near Kitulgalle.

C.P. 3151, Kitulgalle, 1852 or 1853 (PDA, 2 sheets); *Kostermans 28388*, valley of Kelaniya R., near Kitulgalle, alt. ca. 300 m, April, fl. (AAU, G, L, PDA).

15. *Stemonoporus wightii* Thwaites — Fig. 48

Enum. Pl. Zeyl.: 37. 1858 and 403. 1864, as a synon. of *Vateria wightii* Benth.; A.DC., Prodr. 16(2): 620. 1868, as a synon. of *Vatica wightii*; Dyer in Hooker f., Fl. Brit. Ind. 1: 314. 1874, as a synon. of *Vateria ceylanica* Wight; Heim, Recherches Diptér.: 89. 1892; Bull. Soc. Bot. France 39: 153. 1892; Trimen, Handb. Fl. Ceylon 1: 132. 1893; Brandis, J. Linn. Soc. 31: 138. tab. III, 26. 1895; Lewis, Trees & flow. Pl. W. and Sabaragamuwa Prov.: 36. 1902; Veg. Prod. Ceylon: 44. 1934; Alston in Trimen, Handb. Fl. Ceylon 6 (Suppl.): 26. 1931, as a synon. of *Stemonoporus ceylanicus*; Asthon in Fosberg & Dassanayake (eds.), Revised Handb. Fl. Ceylon 1(2): 189. 1977, as a synon. of *S. ceylanicus*; reprint 1: 409. 1980; Kostermans, Bull. Museum nation. Hist. natur. Paris, 4e Sér., Sect. *B. Adansonia* no. 4: 374, fig. 15. 1981. — Lectotypus propositum: C.P. 3415, Sinharaja, Sept. 1855, fl. (PDA).

Vateria wightii (Thw.) Benth. ex Thw., Enum., l.c.: 403. 1864; Dyer, l.c.: 314. 1874, as a synon. of *Vateria ceylanica*; Trimen, Syst. Catal.: 9. 1885; Handb., l.c., as a synon. of *Stemonoporus wightii*; Ashton, ll.cc.; Kostermans, l.c.

Vatica wightii (Thw.) A.DC., Prodr. 16(2): 620. 1868; Dyer, l.c., as a

synon. of *Vateria ceylanica*; Kostermans, l.c.

Vateria ceylanica Wight, Illustr. Ind. Bot. 1: 88. 1840; Thwaites, Enum., l.c.: 37. 1858, with question mark; A.DC., Prodr., l.c.: 620. 1868; Dyer, l.c.: 314. 1874; Trimen, Syst. Catal. Ceylon: 9. 1885; Handb., l.c.: 132, as a synon. of *Stemonoporus wightii*; Ashton, ll.cc. — Typus: Specimen, seen by Dyer (Cal? K?).

Stemonoporus ceylanicus (Wight) Alston in Trimen, Handb. Fl. Ceylon 6 (Suppl.): 26. 1931 "*zeylanicus*"; Ashton, l.c.: 189. 1977; Kostermans, l.c.; Maury & al., Review Palaeobotany and Palynology 19: 246, figs. 1975 (pollen) (zeylanicus).

Stemonoporus macrophyllus Thw., mss. in Herb. Hooker, ex Thw., Enum., l.c.: 37. 1858; Heim, Recherches Diptér.: 89. 1892; Bull. Soc. Bot. France 39: 153. 1892; Kostermans, l.c.

Tree, up to 23 m tall (usually up to about 10 m) and dbh. 35 cm. Bark smooth, grey, thin, hoop-ringed. Live bark 4 mm thick, pale yellow. Sapwood pale yellowish. Branchlets thick, angular, glabrous with large, protruding round leaf scars. Leaves glabrous, coriaceous to sub-coriaceous, elliptic, 15–35 × 8–15 cm, apiculate or shortly acuminate (up to 1 cm, in the seedling 3 cm) to obtuse or slightly emarginate, base obtuse (rarely sub-cuneate); above glossy, midrib thin, prominulous in a shallow groove, the faint lateral nerves sub-impressed (sometimes also the secondary nerves), or surface smooth; below glossy, midrib stout, prominent, lateral nerves 15–21 pairs, rather patent, prominent, at the margin strongly arcuate and for a short distant ascendent; secondary nerves scalariformous, numerous, 2–4 mm apart, perpendicular to lateral nerves, except a few short ones near the midrib. Petioles 3–7.5 cm long, straight or slightly geniculate.

Inflorescences paniculate, many-flowered, axillary, up to 15 cm long (lower branches up to 3 cm long). Main peduncle stout, and towards branches and flowers densely microscopically puberulous and minutely scaly. Pedicel stout, up to 1 cm long. Sepals oblong-ovate, acutish, 8-10 mm long, very sparsely microscopically puberulous outside. Petals ovate, up to 15 mm long, pale yellowish white. Stamens 15, densely minutely puberulous.

Fruit globose-ovoid, rather thick-skinned, longitudinally furrowed, roughish, brown, 1.5 cm high (immature), the sepals hardened, pointing downward. "Cotyledons unequal, outer slightly concave, smooth on the outside, deeply and irregularly furrowed on the inside; inner divided into 3 or 4 lobes and between both cotyledons, a ramified fibrous mass the remains of placenta and dissepiments" (Brandis). There is a possibility that the fruit opens by valves. For a detailed description of the pollen grain see Maury & al. (1975).

DISTRIBUTION: Wet lowlands, near rivers, S.W. Ceylon, from Colombo southwards.

VERNACULAR NAMES: Hal mendora (Hal = *Vateria copallifera*, the fruit is like that one, but smaller and not edible).

NOTE: There is confusion about the proper specific epithet. Thwaites named it *Stemmonoporus wightii* and included with a question mark Wight's

Vateria ceylanica. Apparently he was not sure of the conspecifity and described it hence under another name.

Wight's description is as follows: "*V(ateria) ceylanica* R. W. Leaves obovate, very obtuse, retuse at the point, narrowed at the base; anthers hairy; stigma acute", whereas on p. 87 there is a remark: "*V. ceylanica* which I have added is exactly intermediate between his (Arnott) two subgenera, having the elongated style and acute stigma of the one and the stamens and axillary inflorescence of the other".

This description in so vague, that nothing can be concluded from it, except that it cannot be *S. wightii*, which has never obovate leaves, narrowed to the base.

Dyer saw apparently a Wight specimen (not quoted where), which had the in inflorescence of *Vateria acuminata* and leaves of some unidentified plant; he thought that the specimen might be misticketed.

As the description is not that of our species and neither is the specimen of Wight, I follow Thwaites and Trimen and refer *Vateria ceylanica* to the catagory of an obscure and unidentifiable plant, likely to be a mixture of more than one species.

Thwaites described the leaves as oblong (which means elliptic and linear-oblong), which I do not understand.

Lewis described the leaves as ovate-oblong and gave the number of laterals as 22—25 pairs, this is perhaps not this species (there are more examples of such errors in Lewis's book).

"The petiole of *S. wightii* at the base of the blade has an outer horseshoe of vascular bundles with 16, an inner semicircle with 6 and a central mass with 11, total 33 ducts" (Brandis).

Ashton 2059, Colombo Distr., Kalutara area, 100 m, March, fl. (PDA); *Kostermans 27899*, Bulathsinhala near Horana, marshy forest, low alt., ster. (G, L, PDA); *Meijer 397*, Labugama, W. of Kalutara Reservoir, along river, ster. (PDA); *Kostermans 27228*, Gilimale forest, Ratnapura Distr., low, Dec., after anthesis (K, L, PDA); *C.P. 3415*, Sinharaja forest, Sept. 1855, young fl. (PDA); *sine coll., sine loc., C.P. 3415* (PDA); *Lewis & J.M.S. s.n.*, Ellaboda Kande, seedling, March, 1919 (PDA); *Lewis & J.M.S. s.n.*, March, fl. (PDA); *Lewis*, repeated by Ashton, Ellaboda Kande and Yatipauwa.

16. *Stemonoporus gilimalensis* Kosterm. — Fig. 49

Bull. Museum nation. Hist. natur. Paris, 4e Sér., Sect. *B. Adansonia* no. 4: 378, fig. 16. 1981. — Typus: *Meijer 404* (PDA).

Stemonoporus petiolaris Auct. non Thwaites, Ashton in Fosberg & Dassanayake (eds.), Revised Handb. Fl. Ceylon 1(2): 192. 1977, *quoad specimen Meijer 404*; reprint 1: 415. 1980; Kostermans, l.c.

Tree 5—8 m tall, dbh. 7.5—25 cm. Bark smooth, grey, hoop-ringed. Branchlets thick, angular, apically densely, microscopically light brown pilose. Leaves coriaceous, elliptic-oblong to oblong, 22—35 × 10—15 cm, apiculate or obtuse, base rounded, above smooth, midrib thin, prominulous (in young leaves in a groove), lateral nerves very thin, slightly prominulous in a groove; below glossy, paler, with few, very minute hairs, glabrescent, midrib stout, prominent, lateral nerves rather patent to patent, prominent, near the margin abruptly over a short distance ascendent, not connected,

16–18 pairs, from the midrib short, horizontal secondary nerves; secondary nerves numerous, conspicuous, scalariformous, perpendicular to the lateral nerves, reticulation very obscure. Petiole stout, 6–11 cm long, slightly thickened apically, not geniculate.

Flowers few, glomerulate on small burs at the internode, densely, minutely pilose, hairs straight, adpressed. Pedicel thick, 2–3 mm long. Sepals coriaceous, oblong, 7 mm long, densely pilose. Petals elliptic, obtuse, 1 cm long. Stamens 15; anthers very narrow, pointed, with a narrow, oblique aperture apically and slit further down, densely pilose. Stigma included. Fruit unknown.

DISTRIBUTION: Only known from Gilimale forest near Ratnapura.

NOTE: The holotype specimen was identified as *S. petiolaris* by Ashton, the latter is quite different, with thin, smaller leaves with long slender acumen and very slender petioles and smaller flowers. It is in leaf characters very much like *S. wightii*, but the leaves are more oblong with more lateral nerves, the sessile inflorescence is quite different from the large panicle of *S. wightii*.

The sterile material was from a larger tree (8 m, dbh. 25 cm), but conforms otherwise very well with the type specimen, but the branchlets and leaves are completely glabrous.

Meijer 404, Ratnapura Distr., Gilimale forest, alt. low, wet, evergreen, July, fl. (PDA); *Kostermans 27227, ibid.*, also along river, ster. (PDA).

17. *Stemonoporus scalarinervis* Kosterm. — Fig. 50

Bull. Museum nation. Hist. natur. Paris, 4e Sér., Sect. *B. Adansonia* no. 4: 380, fig. 17. 1981. — Typus: *Ashton 218* (L).

Stemonoporus petiolaris Auct. (non Thwaites), Alston in Trimen, Handb. Fl. Ceylon 6 (Suppl.): 26. 1931; Ashton in Fosberg & Dassanayake (eds.), Revised Handb. Fl. Ceylon 1(2): 192. 1977, p.p., *quoad Ashton 2014, 2038* (in PDA = 2138); reprint 1: 415. 1980; Kostermans, l.c.

Stemonoporus gardneri Auct. (non Thwaites), Ashton, l.c.: 190, p.p., *quoad specimen Lewis s.n.*, Wallankande, Dec. 1893; Lewis, Veget. Prod. Ceylon: 45. 1934.

Tree, up to 15 m high and ca. 20 cm diam. (Ashton). Young branchlets rather thick, microscopically puberulous. Terminal bud small. Leaves coriaceous to rigidly coriaceous, oblong to elliptic, 15–23 × 5–8.5 cm (in juvenile leaves up to 30 × 10, base cuneate), broadly shortly acuminate, tip obtuse, base rounded; above rather glossy, midrib thin, prominulous, lateral nerves impressed, secondary nerves faint, impressed or inconspicous, below paler, rather glossy, midrib strongly prominent, lateral nerves prominent, 10–16 pairs, erect-patent, near margin over a short distance arcuately ascendent, not connected, secondary nerves scalariform, numerous, closely packed, the ones near the midrib at right angles to it, the others more or less at right angles to the lateral nerves, reticulation in between obscure with a sparse, minute indumentum of adpressed scabrous hairs. Petiole slender, 2–5 cm long, juvenile ones densely adpressed puberulous, straight.

Inflorescences axillary and extra-axillary consisting of a very short (up to 3 mm) thickish peduncle and 1–3 (?) sessile flowers, their base with narrowly

ovate, acute thickish minute bracts. Sepals ovate-oblong, acutish, 7 mm long, outside very sparsely microscopically puberulous to glabrous. Petals pale yellow, obovate-spathulate, ca. 1 cm long, longitudinally veined. Stamens 15, anthers puberulous. Fruit unknown.

DISTRIBUTION: Adam's Peak jungle, Gilimale forest near Ratnapura, alt. ca. 100 m.

NOTE: A species not recognized by Ashton, who included it in *S. petiolaris*. It differs by its much thicker and broader leaves, the short, broad acumen and especially by the closely packed scalariform secondary nerves. The flowers are sessile and the sepals not sericeous as in *S. petiolaris*. As most material collected under the Smithsonian Flora Project is badly curated and treated, the scrap material of the broken flowers in the type specimen, is not easy to describe.

It might be only a form of *S. lanceolatus*, but the leaves are larger with many more lateral nerves and denser intercostals.

The specimen of Lewis from Wallankande forest, wrongly indentified by Ashton as *S. gardneri*, had once a fruit, according to the label.

Lewis s.n., Sabaragamuwa Prov., Walankande forest, Dec. 1893, fr. (PDA); *Ashton 2138*, Gilimale forest near Ratnapura, 100 m, May, fl. (PDA, in his paper enumerated as 2038); *Ashton 2014, ibid.*, mile 6, culvert 17, sapling of 7 m and up to 10 cm diam., smooth, grey bark (PDA); *Waas 438, ibid.*, Febr., fl. (PDA), flowers disappeared

18. *Stemonoporus lanceolatus* Thwaites — Fig. 51, 51a

in Hooker's Kew J. Bot. 6: 68. 1854; Enum. Pl. Zeyl.: 38. 1858 and 403. 1864, as a synon. of *Vateria lanceolatus* Benth.; Heim, Recherches Diptér.: 89. 1892; Bull. Soc. Bot. France 39: 153. 1892; Trimen, Handb. Fl. Ceylon 1: 134. 1893; Brandis, J. Linn. Soc. 31: 140. 1895; Lewis, Veget. Prod. Ceylon : 46. 1934; Ashton in Fosberg & Dassanayake (eds.), Revised Handb. Fl. Ceylon 1(2): 191. 1977; reprint 1: 412. 1980; Kostermans, Bull. Museum nation. Hist. natur. Paris, 4e Sér., Sect. *B. Adansonia* no. 4: 382, fig. 18; Nair & al., J. Econ. & Taxon. Bot. 3(3): 650. 1984. — Typus: *C.P. 2658*, Ratnapura, Kuruwita, March 1853, fl. (PDA).

Vateria lanceolatus (Thw.) Benth. ex Thw., Enum., l.c.: 403. 1864; Dyer in Hooker f., Fl. Brit. Ind. 1: 315. 1874; Trimen, Syst. Cat.: 10. 1885; Handb., l.c. (as a synon. of *Stemonoporus lanceolatus*); Ashton, ll.cc.; Kostermans, l.c.

Vatica lanceolata (Thw.) A.DC., Prodr. 16(2): 621. 1868; Dyer, l.c.; Kostermans, l.c.

Tree, up to 7 m tall, bole 10 cm diam. Branchlets and terminal small bud either completely glabrous or densely, microscopically puberulous. Leaves subcoriaceous, lanceolate to narrowly elliptic, 7–20 × 2–8 cm, base obtuse to shortly acute, apex abruptly shortly obtusely acuminate to subcuneate-acuminate (acumen 5–25 mm long); above glossy, glabrous, obscurely, smoothly reticulate, midrib slender, prominulous, lateral nerves slightly impressed, below initially densely, microscopically puberulous, glabrescent, midrib prominent, the 7–12 pairs of lateral nerves erect-patent, towards the margin strongly, arcuately, ascendent, prominent, secondary nerves

scalariformous, distinct, in between a lax reticulation. Petiole slender, usually not geniculate, 12–25 mm long, glabrescent.

Flowers few, solitary or two together, axillary or supra-axillary. Pedicel pubescent, 5–10 mm long. Sepals lanceolate-linear, concave, acute, up to 8.5 mm long, outside microscopically densely puberulous, ca. 2 mm wide at the base. Petals white, up to 8 mm long, oblong to subspathulate-oblong, obtuse. Stamens 15, microscopically pubescent. Style included in the anther-column.

Fruit sub-globose, roughish with rather thin pericarp, brown, up to 2.5 cm diam., the partly reflexed, partly patent sepals up to 12 mm long.

DISTRIBUTION: So far only known from the Kuruwita area at 500 m alt. and from Gilimale forest in wet, evergreen forest.

NOTE: The original description does not mention fruit, hence the holotypus is the sheet in flower from Kuruwita near Ratnapura, fl., March 1853. On the same sheet is a specimen from the same locality, collected Sept. 1859, after the publication had appeared. The fruiting sheet of *C.P. 2658* is marked *Vateria lanceolata* Thw. and hence must be of a later date than the sheet with two flowering branches.

Ashton's label of his specimen *2014* (not mentioned in his paper) from Gilimale indicated as a sapling collection of trees of 7 m and 10 cm diam., which implies that the full grown trees might be even taller. The number Ashton *2010* is not represented in PDA, although indicated as such by Ashton.

The sapling collection shows a dense pubescence on the lower leaf surface and twigs. The specimen *Huber 527* is completely glabrous, although in the flowering stage. It has sparser indumentum on the sepals which are somewhat longer; at this stage I have included it in *S. lanceolatus*.

Most leaves are not geniculate.

C.P. 2658, Ratnapura Distr., Kuruwita, March 1853 and Sept. 1859, fl. (PDA, 2 sheets); *Silva 114*, below Kuruwita and Eratna, Febr., fl. (PDA); *Huber 527*, Ratnapura, Distr., Sudugala near Kuruwita, 520 m, Nov., fl. (PDA).

19. *Stemonoporus latisepalum* Kosterm. — Fig. 52

in Liber gratulat. de Wit: 227, fig. 4. 1980; Bull. Museum nation. Hist. natur. Paris, 4e Sér., Sect. *B. Adansonia* no. 4: 384, fig. 19. 1981. — Typus: *Waas 1688* (PDA).

Tree, 15 m tall, bole 8 m, dbh. 23 cm. main branchlets mostly horizontal. Apical part of branchlets, petioles of young leaves, inflorescence and sepals densely minutely puberulous, the indumentum fugaceous except in inflorescence and sepals. Leaves glabrous, rigidly coriaceous, oblong-elliptic, 11–14 × 6–8 cm, shortly, bluntly, rather broadly acuminate, base rounded; above smooth, midrib slender, prominulous in a shallow depression, lateral nerves slightly impressed, causing bullateness between the lateral nerves; below paler, midrib strongly prominent, lateral nerves 8–10 pairs, erect-patent, arcuate towards the margin, not connected into a marginal vein; secondary nerves close to the midrib slender, prominulous, horizontal, the others

scalariform and ultimately perpendicular to the lateral nerves, reticulation none. Petioles 2–3 cm long, often slightly swollen apically.

Inflorescences extra-axillary, sub-paniculate, 1.5 cm long, flowers and short branches very few. Pedicels thickish, 3 mm. Sepals rather thin, elliptic, concave, 5–6 mm long, 3–3.5 mm wide. Petals yellow, only slightly larger. Stamens 15: filaments short, in groups of three connate at the base. Style slightly exserted. Fruit unknown.

DISTRIBUTION: Sub-montane forest, only known from the type locality.

NOTE: Resembles *S. kanneliyensis* by the venation, but less lateral nerves, a short, broad, obtuse acumen and not impressed midrib. The lateral nerves are not forming a marginal vein. Moreover the inflorescence is paniculate and the sepals unusually broad and resemble the petals. Also near *S. affinis*, but inflorescence longer, the leaves larger and differently shaped; the acumen short and broad.

Waas 1688, Ratnapura Distr., Mangadala Oya forest, along trail to Maskeliya from Malibode, 700 m, June, fl. (PDA).

20. *Stemonoporus affinis* Thwaites — Fig. 53

in Hooker's Kew J. Bot. 6: 68. 1854; Enum. Pl. Zeyl.: 38. 1858 and 403. 1864, as a synon. of *Vateria affinis* Benth.; Atlas t.XV A.DC., Prodr. 16(2): 621. 1868, as a synon. of *Vatica thwaitesii* A.DC.; Dyer in Hooker f., Fl. Brit. Ind. 1: 314. 1874, as a synon. of *Vateria affinis*; Trimen, Handb. Fl. Ceylon 1: 134, tab. 15. 1893; Alston in id. 6 (Suppl.): 26. 1931; Brandis, J. Linn. Soc. 31: 140. 1895; Ashton in Fosberg & Dassanayake (eds.), Revised Handb. Fl. Ceylon 1(2): 189. 1977; reprint 1: 408. 1980; Kostermans, Bull. Museum nation. Hist. natur. Paris, 4e Sér., Sect. *B. Adansonia* no. 4: 386, fig. 20. 1981. — Typus: *C.P. 2430*, Hunasgiriya, at about 4000 ft. (PDA).
Dyer, l.c.: 314; Trimen, Syst. Catal.: 10. 1885; Handb., l.c. (as a synon. of *Stemonoporus affinis*); Ashton, ll.cc.; Kostermans, l.c.

Vatica thwaitesii A.DC., Prodr. 16(2): 621. 1868; Dyer, l.c.; Trimen, l.c.; Ashton, ll.cc.; Kostermans, l.c.

Tree, 8–13 m high, dbh. up to 40 cm, coppicing at base. Bark smooth, grey. Branchlets of flush and midrib of flush leaves underneath very sparsely microscopically puberulous, soon glabrous. Terminal bud small. Branchlets thickish. Leaves stiffly coriaceous, glabrous, subovate-elliptic to elliptic, (4–) 6–11 × (–2) 3–7 cm, rounded and abruptly acuminate (acumen slender, obtuse, up to 1 cm long, in sapling up to 2.5 cm), base rounded; above glossy, midrib thin, prominulous in a shallow groove, lateral nerves thin, obscurely impressed, sometimes the impressed secondary nerves visible, the leaves bullate, below glossy, midrib strongly prominent, lateral nerves 7–8 (–11) pairs, erect-patent, slender, prominent, near margin for a short distance arcuately ascendent, not connected, secondary nerves very slender, scalariformous, in between a dense reticulation. Petioles rather slender, 1–3 cm long, straight, apical part slightly thickened.

Inflorescence axillary, 0–5 mm long, bearing one or two flowers; bracts large, narrowly oblong, acutish, 5 mm long. Pedicels thickish, 5–7 mm long, sparsely, minutely puberulous. Sepals rather fleshy, narrowly oblong to subovate-oblong, rather obtuse or acutish, up to 8 mm long, outside sparsely, microscopically puberulous. Petals whitish yellow (fresh), subovate-orbicular, 1 cm long, obtuse, fleshy. Stamens 15, 4 mm long.

Ripe fruit depressed globose, thick-skinned, smooth, initially slightly ribbed, up to 3 cm diam. and 2.5 cm high, roughish, brown, the sepals hardened, pointing downward. "Embryo bright pink" (Trimen). "Embryo bright pink, cotyledons divided into numerous lobes" (Brandis).

DISTRIBUTION: Knuckles Mts., according to Lewis also Meriacotte Peak (S. and W. flank), upper Bambarabotuwa, upper Atakalan Korale and Rakwana (according to Lewis, repeated by Ashton).

ECOLOGY: Reaches canopy size in the low mountain forest.

NOTE: The ripe fruit is smooth and not grooved as stated by Trimen and is irregularly dehiscent.

The base of the leaves was correctly described by Trimen, they are not subcordate or broadly cuneate as stated by Ashton. They are not scabrous below as stated by Trimen.

Ashton's remarks, that the localities enumerated by Alston (which Alston copied from Lewis, a book, which Ashton did not see) appears to be based on wrong indentification, has no base. The identifications are of Lewis, not of Alston; no specimen are extant.

There are two sheets of *C.P. 2430* in Peradeniya, one has the pencilled notes: Hunasgiriya at 4000 ft., April 1851 and Oct. 1850, with two flowering branches and a package of fruit, and also another pencilled note: Knuckles, Sept. 1858, in fl. The other sheet is a fruiting specimen and is unmarked.

Some mistake is evident in the notes, Thwaites described a flowering specimen in 1854 from Hunasgiriya. Hence the flowering specimen is the holotypus and the attached fruit package belongs to the other unmarked sheet, which was apparently from the Knuckles.

"In receptacle large cavities, filled with resin" (Brandis).

Ashton 2055, Knuckles Mts., Rangala-Corbett's Gap road, 1500 m, March, fr. (PDA); *2056, ibid.*, seedling (PDA); *Nooteboom 3055*, Rangala to Looloowatte, Sept., fr. (L, PDA); *Balasubramaniam 2192*, Rangala, Oct., fl. (G, L); *Kostermans 27524*, fr. (PDA); *sine coll.*, Sept. 1888, ster. (PDA); *Silva 15*, Knuckles, Nov., fr. (PDA); *C.P. 2430*, Knuckles, Sept. 1858 (?), fl. (PDA); *C.P. 2430*, Hunasgiriya, April 1851. fr. (PDA).

21. *Stemonoporus acuminatus* (Thw.) Beddome — Fig. 54, 54a

Fl. Sylvat.: 100. 1870; Trimen, Handb. Fl. Ceylon 1: 133. 1893, p.p., quoad forma a, exclud. *C.P. 3595*, but includ. *C.P. 3474*; Pierre, Fl. for. Cochinch., fasc. 17: tab. 258 G. 1893; Brandis, J. Linn. Soc. 31: 139. 1895; Lewis, Trees & Fl. Pl. W. & Sabaragamuwa Prov.: 37. 1902; Veget. Prod. Ceylon: 45. 1934, localities doubtfull; the note: rare species, apparently found below Badulla under *S. gardneri*, belongs here; Alston in Trimen, Handb. Fl. Ceylon 6 (Suppl.): 26. 1931; Ashton, Blumea 20: 365. 1973; in Fosberg &

Dassanayake (eds.), Revised Handb. Fl. Ceylon 1(2): 188. 1977, p.p., exclud. *C.P. 3595* and *Ashton 2121, 2122, 2123, 2124, 2125, 2126*; reprint 1: 406. 1980; Kostermans, Bull. Museum nation. Hist. natur. Paris, 4e Sér., Sect. *B. Adansonia;* syntypus: *C.P. 3474* (later included in 3595) (PDA).

Vateria acuminata Thw. (non Hayne), Enum. Pl. Zeyl.: 403. 1864, p.p., exclud. *C.P. 3595*; Dyer in Hooker f., Fl. Brit. Ind. 1: 314. 1874, as a synon. of *Vateria jucunda* Thw. ex Dyer, *p.p., exclud. cit. Medamahanuwara*: Trimen, l.c.; Ashton, ll.cc.; Kostermans, l.c.

Vatica acuminata (Thw.) A.DC., Prodr. 16(2): 622. 1868, *p.p., exclud. C.P. 3595*; Dyer, l.c.; Kostermans, l.c.

Vesquella acuminata (Thw.) Heim, Recherches Diptér.: 90. 1892, combination not printed; Bull. Soc. Bot. France 39: 153. 1892; Dyer, l.c.: 383; Brandis, l.c.: Ashton, ll.cc.; Kostermans, l.c.

Vateria jucunda Thw. ex Dyer in Hooker f., Fl. Brit. Ind. 1: 314. 1874; Trimen, Syst. Catal: 10. 1885; Handb. Fl. Ceylon, l.c. (as a synon. of *Stemonoporus acuminatus*); Ashton, ll.cc.; Kostermans, l.c.

Sunapteopsis jucunda (Thw.) Heim (combination not printed), Recherches Diptér.: 92. 1892; Dyer, l.c.; Brandis, l.c.; Ashton, ll.cc.; Kostermans, l.c.

Tree 12–20 m tall, dbh. 20–40 cm. Branchlets thickish with microscopical scales and simple hairs or glabrous. Leaves coriaceous, glabrous (in very young leaves midrib below puberulent), varying from lanceolate-oblong to elliptic oblong to ovate-oblong, 7–17 × 2.5–7 cm, gradually acuminate to acuminate (acumen with broad base, 0.5–3 cm long), base rounded to obscurely sub-cordate, above glossy, smooth to obscurely densely reticulate, midrib thin, prominulous or so in a slight depression; below glossy, densely, microscopically, obscurely reticulate, midrib prominent; lateral nerves 8–12 pairs, slender, erect-patent, arcuate (especially at the margin), connected by obscure but distinct scalariform secondary nerves. Stipules (Thwaites) falcate-lanceolate, 7.5 mm, caducuous (might be also *S. laevifolius*). Petiole slender, 3–7 cm, straight.

Inflorescences axillary and extra-axillary, consisting of bundles of few-flowered, 1–5 cm long racemes or the slender, puberulent peduncles having a few short branchlets. Pedicels microscopically puberulous, ca. 5 mm long. Sepals oblong to subovate-oblong, acutish, sparsely puberulous (denser at base), up to 7 mm long, acutish. Petals slightly longer, oblong, yellowish. Stamens 15.

Fruit depressed globose, rusty, roughish, rather thin-skinned, up to 3 cm diam., 2.5 cm high; the sepals not enlarged, hardened, turned downwards. "Cotyledons thin, flat, much folded and crumpled. Unripe seed with some gelatinous albumen. The embryo does not fill up the cavity completely, at the base of the pericarp inside is a fleshy, laciniate cup" (Brandis).

DISTRIBUTION: S.W. Ceylon, Sinharaja forest, Rakwana part, and Ambagamuwa Prov. Wet forest.

NOTE: As discussed under *S. laevifolius*, Trimen already recognized two forms in the classical material of *S. acuminatus* at his disposal. This was confirmed by Ashton, who collected additional material. *S. acuminatus* proper I have restricted to *C.P. 3687* (PDA) and the sheet originally *C.P. 3474*, later included (PDA) in *C.P. 3595*, marked Badulla. It is easly separable

from *S. laevifolius* (formerly *S. acuminatus, C.P. 3595*) by the conspicuous more erect and more arcuate and less numerous lateral nerves (on the lower leaf surface) and by the puberulous sepals. One sheet of *C.P. 3687* (PDA) bears a flowering branchlet with much broader leaves, corresponding with those collected by Ashton on Kiribatgalle. With the scanty material at hand, I have left collections together, Ashton has selected *C.P. 3687* as the lectotype, in which I agree.

In the treatment by Lewis (Useful plants, l.c.) there are discrepancies. The quotation Badulla, belonging to this species is mentioned under the foregoing *S. gardneri*. Furthermore he says that the species is rare, but the enumerates a host of localities, which I have hence not repeated here.

The Badulla specimen, mentioned by Thwaites, is quoted by Trimen as collected by J. Bailey. It was apparently first numbered *C.P. 3474*, but mentioned by Thwaites in brackets (I cannot explain why), Trimen left the brackets out. In Peradeniya it is numbered *C.P. 3595*. It might have been collected from a locality in the utmost western part of Badulla Distr., which conforms with the localities, enumerated here.

The broader leaved specimens show much likeness to *S. affinis*, but the leaves have many more lateral nerves. It is certainly related to *S. gardneri*.

"The sepals are slightly imbricate (in fig. 11 of Pierre incorrectly valvate)" (Brandis).

Heim based *Vesquella* on the fibrous, laciniate cup at the base inside of the pericarp; this was found later by Brandis also in *S. canaliculatus*.

Sunapteopsis Heim was published in a way not common and not advisable in taxonomy: "Genre ? *Sunapteopsis* Heim, vel. *Stemonoporus* sect." He said that he wanted to create a new name for *Vateria jucunda* Thw. *fide* Dyer, but failed also to print that new name.

Heim saw no flowers and created his doubtfull genus mainly on the characters: large, no reflexed unequal sepals under the fruit. Furthermore he quoted erroneously 25 instead of 15 stamens. In the subsequent publication in Bull. Soc. Bot. France, the genus has disappeared noiselessly and appears the name *Vesquella acuminata* Heim.

Beddome's plate has the stamens wrongly drawn. They are much longer and only the tip of the style emerges. Furthermore the anthers have the normal shape of those of *Stemonoporus*: the margins of the larger valve touch each other and leave an oblique apical aperture, the lower valve, clasped by the margins of the larger valve, closes the basal part of the anther.

Thwaites — after having named the species *Vateria acuminata* — discovered that the specific epithet was occupied by *Vateria acuminate* Hayne and changed the name in mss. to *Vateria jucunda*. The latter name was taken up by Dyer (not by Trimen, as Ashton says) and validly published, not a nomen as erroneously quoted by Ashton. As *Vateria acuminate* Hayne is based on a specimen, different from that of *Vateria acuminata* Thw., the specific epithet can be used in *Stemonoporus*.

Ashton 2122 and *2123*, Pelmadulla, Kiribatgalle, bamboo forest, rocky, 900 m, March fl. (PDA); *2124, ibid.*, sapling of 2 m, leaves 16 × 6 cm, petiole 7 cm long (PDA); *Kostermans 28032, ibid.*, ster. (L); *Waas 1756*, Marathagaa, Ratnapura Distr., 1200 m, June, fr. (PDA); *J. Bailey s.n.*, Badulla Distr., fl. (PDA = *C.P. 3474*, later in PDA: *C.P. 3595*); *C.P. 3687*, Ambagamuwa Prov., Nov. 1850 or 1852, fl. (PDA, 2 sheets); W. of Eldorado Estate,

Rakwana (Lewis and quoted also by Ashton; no specimen); *Gunatilleke 6091 A*, Deniyaya side of Sinharaja forest, 900 m, Dec., fl. (G, L, PDA); *Kostermans 28100, ibid.*, March, young fr. (L).

22. *Stemonoporus moonii* Thwaites — Fig. 55, 55a, 55b.

Enum. Pl. Zeyl.: 39. 1858, with question mark; ibid.,: 403. 1864, as a synon. of *Vateria moonii*; A.DC., Prodr. 16(2): 622. 1868, as a synon. of *Vatica moonii*; Trimen, Handb. Fl. Ceylon 1: 137. 1893; Alston in id. 6 (Suppl.): 27. 1931; Brandis, J. Linn. Soc. 31: 142. 1895; Lewis, in the Ceylon Observer (date unknown, quoted by Alston); Ashton, Blumea 20(2): 366. 1972, as an exclud. species; in Fosberg & Dassanayake (eds.), Revised Handb. Fl. Ceylon 1(2): 193. 1977; reprint 1: 418. 1980; Kostermans, Bull. Museum nation. Hist. natur. Paris, 4e Sér., Sect. *B. Adansonia* no. 4: 391, fig. 22. 1981. — Typus: *C.P. 1792* (PDA).

Vateria moonii (Thw.) Benth. ex Thw., Enum., l.c.: 403. 1864; Dyer in Hooker f., Fl. Brit. Ind. 1: 316. 1874; Trimen, Syst. Cat.: 10. 1885; Handb. l.c.; Lewis, Veget. Prod. Ceylon: 49. 1934; Ashton, ll.cc.; Kostermans, l.c.

Vatica moonii (Thw.) A.DC., Prodr. 16 (2): 622. 1868; Dyer, l.c.; Kostermans, l.c.

Small, slender tree, up to 4 m tall with few, short branches, the bole up to 4 cm in diam., with grey, smooth bark, the tree resembling strongly *Agrostistachys (Euphorbiaceae)* and equally called in Sinhala; *beroo*. The stems often flopped over and the side branches curved upwards. Branchlets thick with large, round, protruding leaf scars, apically densely brown pilose (hairs long, simple). Stipules persistent, linear or very narrowly lanceolate-linear, acute, 1.5—4 (flush) cm long, initially densely pilose, soon glabrous. Flush leaves pendulous, stiff, completely enrolled, greyish brown. Leaves aggregate at the apex of the branches, stiffly coriaceous, narrowly subovate oblong, 14—48 × 2.5—8 cm, rather obscurely to distinctly acuminate, gradually tapered to the rounded base; above glabrous, glossy, smooth or obscurely reticulate, the lateral nerves and the accessory ones impressed, midrib thin, prominulous; below paler, glossy, midrib prominent, lateral nerves 12—30 pairs, slender, prominent, erect-patent, strongly arcuately sub-ascendent, the lowest pair sometimes more erect; in between much shorter accessory lateral nerves; secondary nerves thin, prominulous, near the midrib prependicular to the midrib, towards the margin perpendicular to the lateral nerves, parallel, in between rather lax, obscure, minute reticulation. Petioles 6—20 mm long, thickish, densely pubescent, glabrescent.

Flowers solitary or in bundles of 1—3 in the axils of fallen leaves just below the leaves. Pedicel up to 2 mm long, densely pubescent, subtended by linear, long bracts. Sepals narrowly lanceolate, acutish, up to 12—13 mm long, outside densely or sparsely light brown pubescent. Petals elongate-ovate, acute, up to 11 mm long, inside white, outside with a central light red longitudinal band. Style thin, 2 mm long, the minute stigma visible above the cone of 15 stamens. Stamens white with short filaments, the upper anther valve bulging in the centre, folded, resulting in an oblique tubular slit apically and one slit below the bulge.

Fruit sub-globose, 3 cm diam., light brown, pericarp thin (1 mm), divided into polygonal "fields", scurvy; cotyledons very large, folded, conduplicate,

green; radicle 1 cm long, 4 mm diam., red, with minute appressed hairs, except the tip: sepals linear, appressed to the fruit base.

DISTRIBUTION: Marshy, periodically inundated land along slow running streamlet in lowland in Kalutara Distr., Matugama area near Bulatsinhala near Honaka.

NOTE: Thwaites commented on this species, of which at the time (1858) only two specimens were known. collected by Moon around about 1820–25, one according to Thwaites was sterile, the other had flower buds, which he dissected and found to his surprise that this was a *Stemonoporus* with the correct number of stamens, etc., but because of the peculiar long numerous stipules, he included it in *Stemonoporus* with an interrogation mark and mentioned its locality as Maturata, likewise with an interrogation mark. Trimen in 1893 described the pedicels and sepals. He had apparently at hand the sole sheet, now in the Peradeniya Herbarium. He commented on the species as: "It is greatly to be hoped, that this curious plant may be rediscovered."

Ashton failed to look in the convolute, attached to the Peradeniya sheet, which he annonated and stated erroneously, that the sheet was now sterile. although it had still two flowers without corolla and stamens.

Not taking heed of Thwaites's remark, he opinioned that this was not *Stemonoporus* but likely *Sterculiaceae* or even *Euphorbiaceae*.

Alston produced some confused statements. "It is scarcely like to belong to *Stemonoporus* and may not even be a Dipterocarp at all" and then some line further: "should probably form a separate genus" (in *Dipterocarpaceae*). Thwaites thought that Moon's specimen perhaps was from Maturate, which is in the mountains near Nuwara Eliya. I am sure that this is a mistake for Matugama in the lowland, Kalutara District, near the place where we found the tree.

Lewis noted, that he had seen it in the Maguru Ganga valley near Honaka, on waturana land, but unlucky had not collected it (waturana is wet land).

Following this tip of Lewis I started investigations on Maguruganga near Honaka and by a lucky coincidence, this was also the home site of Dr. Gunatilleke, who approached a rubber planter in the Bulatsinhala area, who informed him that he was the private owner of a small patch of Marshy forest along a streamlet.

Dr. Gunatilleke and I explored this mosquito infested, degraded forest, but failed to find *Stemonoporus moonii*, although several other very rare trees were discovered.

Not wanting to give up, I suggested to follow the rivulat and our perseverence was rewarded and many specimens of *Stemonoporus moonii*, believed to be extinct, were discovered were along a muddy depression with *Areca coccinea* (in itself a rare tree) and along the streamlet. Some weeks later I could manage to collect the flowers, which corroborated my previous opinion that this was a "good" *Stemonoporus*. I found also the last existing specimen of Mesua stylosa; now it exsists only in the Botanical Garden of Peradeniya and one tree is in the Bogor Botanical Garden.

I wrote a personal letter to the President of Sri Lanka (Mr. Jayawardhena) to ask his help to protect this costly piece of swampy forest, perhaps the last, not converted into paddi fields, and received immediately support.

Kostermans 27857, Kalutara Distr., Bulatsinhala, near Honaka, rubber estate Walauwewatte, ca. 25 miles E. of Kalutara, along muddy, swampy rivulet, 7 Oct. 1979, ster. (G, L, PDA); *27961*, Dec., in flush (G, L); *27880*, 19 Oct., fl. (AARH, G, L, PDA); *Moon s.n., C.P. 1792*, near Matugama, fl. (PDA).

Subgenus Monoporandra (Thw.) Kosterm.

Bull. Museum nation. Hist. natur. Paris, 4e Sér., Sect. *B. Adansonia* no. 4: 393. 1981.

Monoporandra Thw. in Hooker's Kew J. Bot. 6: 69. 1854.

Stemonoporus sect. *Monoporandra* (Thw.) Heim, Recherches Diptér.: 89. 1892.

Stamens 5. Ovary 2, rarely 3-celled. Species 4.

23. *Stemonoporus cordifolius* (Thw.) Alston — Fig. 56, 56a

in Trimen, Handb. Fl. Ceylon 6 (Suppl.): 27. 1931; Worthington, Ceylon Trees: 71. 1959; Asthon in Fosberg & Dassanayake (eds.), Revised Handb. Fl. Ceylon 1(2): 190. 1977, exclud. *Lewis s.n.*, Meddakande, Balangoda, quoad *S. angustisepalum*; reprint 1: 410. 1980; Kostermans, Bull. Museum nation. Hist. natur. Paris, 4e Sér., Sect. *B. Adansonia* no. 4: 393, pl. 23. 1981. — Typus: *C.P. 2647*, Ambagamuwa & Saffragam Distr., 1000 m, fl. (PDA, 2 sheets).

Monoporandra cordifolia Thw. in Hooker's Kew J. Bot.: 6. 70. 1854; Enum. Pl. Zeyl.: 39. 1858; A.DC., Prodr. 16(2): 637. 1868; Beddome, Fl. sylv., tab. 101. 1870; Dyer in Hooker f., Fl. Brit. Ind. 1: 317. 1874; Pierre, Fl. for. Cochinch., fasc. 17: tab. 258, F. 1892; Trimen, Syst. Catal.: 10. 1885 & Handb. Fl. Ceylon 1: 137. 1893; Brandis, J. Linn. Soc. 31: 142. 1895; Ashton, l.c.; Kostermans, l.c. 394; Nair & al., J. Econ. & Taxon. Bot. 3(3): 650. 1984.

Vateria cordifolia (Thw.) Thw., Enum., l.c.: 404. 1864; A.DC., l.c.: 637; Dyer, l.c.: 317 (as a synon. of *Monoporandra cordifolia*); Trimen, l.c.; Ashton, l.c.; Kostermans, l.c. 394.

Tree, up to 15 m tall, bole up to 6 m and 35 cm in diam. Flush yellowish. Bark smooth, grey, obscurely fissured, strips somewhat wavy, 1—2 mm wide. Live bark 3 mm, pale. Branchlets slender, puberulous or glabrous. Terminal bud small. Leaves coriaceous, glabrous (except midrib below in young leaves), ovate or oblong-ovate, 3—11 × 1.5—5 cm, conspicuously acuminate (acumen obtuse, slender, 1—3 cm long), base rounded to subcordate and here with slightly incurved margins, both sides glossy, upper surface with thin, impressed midrib, the laterals faint, sometimes in an obscure groove, very minutely areolate-reticulate, below midrib prominent, the 6—7 erect-patent lateral nerves thin but very distinct, arcuate near the margin, secondary nerves parallel, horizontal, the basal ones more perpendicular to the lateral nerves, reticulation with a very fine mesh. Pedicel very thin and long, usually strongly geniculate, 1—2.5 cm long, glabrous or sparsely puberulous.

Panicles axillary, glabrous to minutely puberulous, up to 2.5 cm long with thin peduncles and short, thin branches, up to 6-flowered. Pedicel filiform, 1 cm long. Sepals narrowly ovate-lanceolate, up to 4 mm long, acute. Petals lemon-yellow, oblong, up to 10 mm long. Stamens 5, densely puberulous,

narrowly ovate, acute, the apical marginal parts of the large valve completely touching each other, forming a tube with oblique opening at apex. Ovary 2–3-celled, puberulous. Style slightly shorter than the stamens. Fruit globose, thick-skinned, 1–1.5 cm diam., red-brown, scabrous, the sepals not enlarged, pointing downward.

DISTRIBUTION: Southern slopes of Adam's Peak, between 700 and 1000 m approx., locally not umcommon.

NOTE: The species is very close to *S. elegans* and could be considered to be only a variety, but the acumen is not so pronounced and slender, the reticulation is finer, the petioles are longer and thinner, the inflorescences are paniculate with 6 flowers (sometimes also paniculate in *S. elegans*, but with less flowers). The main difference, however, are the conspicuous lateral nerves on the lower leaf surface (in *S. elegans* very obscure).

Ashton called the lateral nerves first obscurely elevated above, but some lines further he calls them shallowly impressed, actually they are slightly prominulous, but often in a slight depression; the secondary nerves are only scalariform in part of the leaf.

De Candolle called the inflorescence a raceme, however, they are paniculate. The petals are much longer than indicated by Ashton.

The species occurs also in secondary forest and in non-Dipterocarp forest.

The specimen *Lewis s.n.* from Meddakande, Balangoda, enumerated by Ashton, represents *S. angustisepalum*.

C.P. 2647, Ambagamuwa, Dec. 1852, fl., fr. (PDA, 3 sheets); *Ashton 2139* and *2140*, Balangoda-Bogawantala Rd., 1600 m, May, buds (PDA); *Meijer 963, ibid.*, ster. (PDA); *Bernardi 15994, ibid.*, 1800 m, Dec., fr. (PDA); *Nooteboom 3393, ibid.*, 1470 m, Oct., fl. (PDA); *Worthington 3232*, Balangoda Estate forest, 1400 m, Oct., fl. (PDA); *770, ibid.*, 1300 m, ster. (PDA); *6546, ibid.*, Galbodde, ster. (PDA); *Ashton 2114*, above Carney Estate, Gilimale forest, Apr., buds (PDA); *Huber 535*, mountains N. of Maratenne, Nov., fl. (PDA); *844*, Aug., fl. (PDA); *Waas 1728* and *1730*, 1000 m, June, fl. (PDA).

24. *Stemonoporus elegans* (Thw.) Alston — Fig. 57

in Trimen, Handb. Fl. Ceylon 6 (Suppl.): 27. 1931; Asthon in Fosberg & Dassanayake (eds.), Revised Handb. Fl. Ceylon 1(2): 190. 1977; reprint 1: 411. 1980; Kostermans, Bull. Museum nation. Hist. natur. Paris, 4e Sér., Sect. *B. Adansonia* no. 4: 396, fig. 24. 1981. — Typus: *Gardner s.n., C.P. 371*, Base of Adam's Peak, fl. (PDA, 2 sheets).

Monoporandra elegans Thw. in Hooker's Kew J. Bot. 6: 69, tab. 2, fig. B. 1854; Enum. Pl. Zeyl. 39. 1858; A.DC., Prodr. 16(2): 636. 1868; Dyer in Hooker f., Fl. Brit. Ind. 1: 317. 1874; Trimen, Syst. Catal.: 10. 1885; Handb. Fl. Ceylon 1: 138. 1893; Brandis, J. Linn. Soc. 31: 142. 1895; Ashton, ll.cc.; Kostermans, l.c.; Nair & al., J. Econ. & Taxon. Bot. 3(3): 649. 1984.

Vateria elegans (Thw.) Thw., Enum., l.c.: 404. 1864; Trimen, l.c.: 138; Ashton, ll.cc.; Kostermans, l.c.

Small to medium sized tree (cf. note), glabrous in all its parts. Branchlets thin, glossy; terminal bud small. Leaves coriaceous, slightly concave, oblong

to elliptic, very rarely subovate-oblong, 5–9 × 1.5–3 cm, caudate-acuminate (acumen slender, obtuse, 5–20 mm long), base shortly acutish to rounded and here the margins often revolute, both sides glossy, obscurely smoothly reticulate, above the thin midrib impressed, below midrib prominent, the 6–8 pairs of erect-patent lateral nerves thin, prominulous, as strong as the intermediate reticulation, but visible, lateral nerves at margin strongly arcuate. Petiole thin, not geniculate, 5–10 mm long.

Racemes subterminal and axillary, sometimes paniculate, few to 6-flowered, peduncle thin, up to 15 mm long; pedicel thin, 5– 10 mm long. Sepals narrowly ovate, acute, up to 5 mm, microscopically sparsely adpressed puberulous. Petals oblong, longer than sepals, yellowish white to lemon yellow; buds yellow. Stamens 5, the large flap with completely closed margin, forming a tube with a terminal oblique opening. Ovary 2-celled. Style obscured by the stamens, stigma punctate. Fruit globose, thin-skinned, 10–15 mm diam., the 3–5 mm long thin sepals turned downward. "Unripe seeds have thin fleshy cotyledons emarginate at apex." (Brandis).

DISTRIBUTION: Southern slopes of Adam's Peak, at about 1000 m altitude, rather common.

NOTE: Most labels give the tree as from 3–8 m high, Ashton 2915 states that it is 20 m high and 30 cm in diam. (in his paper he states 20 m, but only 20 cm diam.). The leaves are certainly not ovate as described by Ashton, lanceolate as described by Trimen. De Candolle described them correctly as oblong to sub-elliptic.

Waas indicates the petals as white, Ashton as dark lemon yellow, Davidse as yellowish white. Unluckily the Flora Project material is so badly conserved and mounted that not a single flower is present.

Gardner s.n., C.P. 371, Adam's Peak, at ca. 700 m, fl., fr. (PDA, 2 sheets); *Davidse & Sumitraarachchi 8742*, N.E. of Carney, S. approach of Adam's Peak, Nov., fl. (PDA); *Bernardi 15789, ibid.*, Dec., fr. (PDA); *Meijer 509, ibid.*, 1000 m, July, fl. (PDA, in package wrong flower); *Ashton 2915, ibid.*, 900 m, Apr., fl. (PDA), *quoted as 2115*; *Waas 1833, ibid.*, Dotuagale forest, 1000 m, Aug., fl., fr. (PDA).

25. *Stemonoporus angustisepalum* Kosterm. — Fig. 58

in Liber gratulat. de Wit : 208. 1980; Bull. Museum nation. Hist. natur. Paris, 4e Sér., Sect. *B. Adansonia* no. 4: 398, fig. 25. 1981. — Typus: Waas 1608 (PDA).

Stemonoporus cordifolius Auct. (non Alston) Ashton, in Fosberg & Dassanayake (eds.), Revised Handb. Fl. Ceylon 1(2): 190. 1977, *quoad Lewis s.n.*, in adnot.; reprint 1: 410. 1980; Kostermans, l.c.

Stemonoporus affinis Auct. (non Thwaites), Ashton, l.c.; Kostermans, l.c.

Tree up to 15 m high with up to 8 mm long bole, up to 25 cm diam. Bark smooth, grey with longitudinal rows of lenticells. Apex of branchlets and the small terminal bud with fugaceous, extremely short rather sparse indumentum. Leaves rigidly coriaceous, glabrous, elliptic, 5–15(–17) × 2–8 cm, shortly, abruptly acuminate, acumen slender, 4–10 mm long, base rounded; above bullate to sub-bullate, midrib, lateral and usually secondary nerves

impressed; below paler, midrib strongly prominent, the 8–11 pairs of erect-patent lateral nerves prominent, near the margin arcuate and in the upper half of the lamina often arcuately connected, forming there an intramarginal vein; secondary nerves prominent, scalariformous, perpendicular to the lateral nerves, reticulation of similar pattern, obscure. Petiole slender or thickish, 2–4.5 cm long.

Inflorescences axillary or extra-axillary, paniculate, few-flowered, laxly, extremely minutely puberulous. Pedicels thickish, 2–3 mm long. Sepals narrowly lanceolate, acute, 4 mm long, at base 1.5 mm wide, in sicco rolled up and looking linear, outside sparsely puberulous. Petals yellow, oblong, glabrous, 4 mm long. Stamens 5, 25 mm long, obscuring the slighlty shorter style. Ovary glabrous.

Fruit globose, 1.5 cm diam., thin-skinned, rusty, roughish (tiny flat scales). Cotyledons not folded.

DISTRIBUTION: Ratnapura and Balangoda District, lower montane forest in Adam's Peak jungle.

NOTE: The leaves resembles those of *S. bullatus*, but are much smaller. It has an impressed midrib on the upper leaf surface, and can, apart from the number of stamens (5) easily be distinguished from *S. canaliculatus* and *S. bullatus* by the paniculate inflorescence. Two collections (*Lewis s.n.* and *Waas 1721*) have much smaller leaves (5–8 × 3–4.5 cm) than the other three collections (10–17 × 5.5–7 cm), but otherwise I cannot find any difference.

Lewis s.n., Balangoda Distr., Medde Kande, March, fl. (PDA); *Kostermans 24460*, above Balangoda, Tumbagoda Road, Tamanawatte to Masenna, Adam's Peak Jungle, 600 m, June, fr. (G, K, L, PDA, US), distributed as *Aporosa*; *Waas 1721*, Ratnapura Distr., Malaboda forest, 1800 m, June fl. (PDA); *1580*, Kuttapitiya, 1100 m, June, fl. (PDA); *1608*, Agars Land forest, 800 m, May, fl. (PDA).

26. *Stemonoporus scaphifolius* Kosterm. — Fig. 59, 59a.

Bull. Museum nation. Hist. natur. Paris, 4e Sér., Sect. *B. Adansonia* no. 4: 400, fig. 26, 27. 1981. — Typus: Kostermans 28458 (G).

Tree 10 m high, dbh. 15 cm. Bark grey, smooth, thin, hoop-ringed. Wood white. Branchlets stiff, glabrous, like the small terminal bud. Leaves patent, but mostly drooping, concave, glabrous, elliptic or oblong, coriaceous, stiff, 15–25 × 5–9 cm, caudate-acuminate (acumen slender, obtuse, up to 4 cm long), base rounded or sub-cordate; above very glossy, rather smooth, midrib strongly impressed (up to the tip of the acumen), lateral and secondary nerves impressed, making the leaf bullate; below paler, glossy, midrib strongly prominent, lateral nerves slender, prominent, erect-patent, near the margin abruptly arcuately ascendent, 9–12 pairs, secondary nerves thin, parallel (those off the midrib horizontal). Petiole rather slender, 2–4 cm long, slightly thickened apically.

Inflorescences extra-axillary, rather few-flowered, few-branched panicles, up to 4 cm long, glabrous, the lowest branch long, the other very short. Pedicels thickish, 1.5–2 mm long, subtended by a tiny bract. Sepals 5, narrowly elongate-triangular, acute, fleshy, stiff, 4–5 mm long. Petals white,

elliptic-spathulate, rather fleshy, up to 5 mm long, obtuse. Stamens 5, on very short filaments, opening in the usual way by an apical slanting aperture and one somewhat lower down, formed by the incurved margins of the large valve.

Fruit (immature) rusty brown verruculous because of small polygonal areas, 1.5 cm diam., the unaltered sepals stiff, pointing downwards.

DISTRIBUTION: Only known from the type locality.

NOTE: The 5 stamens places this in subgenus *Monoporandra*. From the other representatives of that subgenus it differs considerably in leaf size, texture and shape. Peculiar are the folded, scaphiform leaves, which occur also in *S. revolutus* (this has obtuse, erect, much smaller leaves). I know only *Sunaptea scaphifolia* from East Indonesian Borneo with similar strongly concave pendulous leaves. This is the normal situation, the tree was very healthy, the climate very wet.

Kostermans 28458, Ratnapura Distr., N. of Bamberabotuwe For. Res., alt. ca. 400 m, May, fl., young fr. (AAU, G, L, PDA).

Excluded Species

1. *Vateria (Stemonoporus) disticha* Thw., Enum. Pl. Zeyl.: 404. 1864 = *Stemonoporus distichus* (Thw.) Heim, Recherches Diptér.: 72. 1892 = *Sunaptea (?) disticha* (Thw.) Trimen = *Doona disticha* (Thw.) Pierre = *Vatica disticha* (Thw) A.DC., = *Shorea disticha* (Thw.) Ashton.
2. *Vateria (Stemonoporus) scabriuscula* Thw., Enum. Pl. Zeyl.: 404. 1864 = *Stemonnoporus scabriusculus* (Thw.) Heim, Recherches Diptér.: 89. 1892 = *Vatica scabriuscula* (Thw.) A.DC. = *Sunaptea scabriuscula* (Thw.) Trimen = *Dyerella scabriuscula* (Thw.) Heim = *Cotylelobium scabriusculum* (Thw.) Brandis = *Sunaptea scabriuscula* (Thw.) Trimen.
3. *Stemonoporus "roseus"* Trim., Handb. Fl. Ceylon 1: 136. 1893 ex Durand & Jackson, Index Kewensis Suppl. 1: 400. 1906 (*sphalm.* = *S. nervosus*). — *Vateria "rosea"* Thw. l.c. (*sphalm.* = *Vateria nervosa* Thw.)
4. *Stemonoporus lewisianus* Trimen ex Hooker f., in Trimen Handb. Fl. Ceylon 5: 383. 1900; Lewis, Trees & fl. Pl. W. and Sabaragamuwa Prov. 37. 1902; Veget. Prod. Ceylon 49. 1934; E.J. Livera, in Ann. Roy. Bot. Gard. Peradeniya 9: 97. 1924 (as a synon. of *Vatica lewisiana*); Alston in Trimen, Handb., l.c. 6 (Suppl.): 26. 1931 (as a synon. of *Vateria ? lewisiana*); Ashton in Blumea 20: 358. 1972 and in Fosberg & Dassanayake (eds.), Revised Handb. Fl. Ceylon 1(2): 167. 1977 (as a synon. of *Cotylelobium lewisianum*); reprint 1: ? 1980. -- *Vatica lewisiana* (Trimen ex Hooker f.) Livera, l.c. plate XI C, 1–4; Lewis, Veget. Prod., l.c.; Alston, l.c. (as a synon. of *Vateria ? lewisiana*); Ashton, ll.cc. (as a synon. of *Cotylelobium lewisianum*). — Typus: *Lewis s.n.*, Jan. 1893 (K, PDA, 2 sheets).

Ashton's typification of this species is wrong. Hooker cited the specimen as: Hunawalkande near Pelmadulla, *F. C. Lewis*, January 1893 (not April 1893, as Ashton says). This is a specimen in flower (PDA, 2 sheets). The specimen April 1893, not mentioned by Hooker, is in fruit (PDA, one sheet),

In PDA there is moreover a sterile branch with large leaves collection by Lewis in November 1891.

Hooker gave the number of the stamens as 25, which — according to me — is simply a misprint, as is evident from Hooker's remark that " if this species is to be retained in the genus *Stemonoporus*, the generic character of the latter must be modified to include a plant with a long subulate process. terminating the anther". The aberrant number of stamens is nowhere mentioned.

Livera moved the species to *Vatica* and stated the correct number of stamens (15). He presented the following arguments: 1. Calyx enlarged in the fruit; 2. Stamens not monadelphous (slightly or hardly so in *Stemonoporus*); 3. Anthers dehisce laterally; 4. Connective prolonged to an apiculum.

The most important arguments are the connective appendage (already stressed by Hooker) and the dehiscence. But Livera mentioned also the valvate calyx, an important argument for *Vatica*. The fruit sepals are indeed enlarged, but they are very young and all infested (galls).

Alston's discussion must have been written in a momment of aberration. First he says: Stamens 15 in 2 rows. Then in the discussion : Stamens 25. Alston's only argument to move it to *Vateria* is that *Vateria* had been suggested by Trimen in mss.

Ashton's argueing is also confused. He says: "The previous incorrect placing of this species was partially because of the undue emphasis placed on the value of the characters of the fruit calyx (sic!, the entire system of *Dipterocarpaceae* is mainly based on calyx characters) and partially because the number and is certainly not an argument for *Stemonoporus* and *Vatica*. Moreover the move to *Vatica* was based on the correct number (Livera). The argument of the valvate sepals, mentioned by Livera is not mentioned by Ashton, who considers this an important character (cf. his Manual of Dipterocarp trees of Brunei).

The shape of the flower, calyx and corolla (petals drop separately), the shape of the anther with appendix, number of stamens, valvate sepals and enlarging fruit sepals point all to *Vatica* and I believe that Livera was right, that the species belongs in *Vatica*. It has nothing in common with *Sunaptea (Cotylelobium)*.

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Abbreviations

AAU = Botanical Institute, Aarhus University, Denmark
BM = Natural History Museum, London, England
BO = Bogor Herbarium, Indonesia
C = Copenhagen Herbarium, Denmark
G = Herbarium Genéve, Switzerland
K = Herbarium Kew Bot. Garden's, England
L = Rijksherbarium, Leiden, The Netherlands
LD = Herbarium Lund, Sweden
PDA = Herbarium Peradeniya Bot. Garden, Sri Lanka
US = Herbarium, Smithsonian Institution, Washington, U.S.A.
dbh = diameter breasthigh

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(order from Dr. Kostermans, Herbarium Bogoriense, Jalan Juanda 22 Bogor, Indonesia. costprice plus mailing).

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1971 A new Ceylonese species of Abarema Pitt., Idem 9(2) 3 pages
1973 A forgotten Ceylonese Cinnamon tree. Idem 10(2) 3 pages
1975 Notes on Clusiaceae of Srilanka. Idem 12(1) 15 pages
1976 The identity of Burman's Catte Coronde, Idem 12(1) one page
1977 Miscellaneous botanical notes. Idem 12(2) 17 pages
1977 Notes on Ceylon Ebony trees. Idem 12(2) 20 pages
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1980 Memosaceae in Fosberg & Dassanayake, Revised Handbook Flora Ceylon 1 55 pages
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1992 Lauraceae in Fosberg & Dassanayake, Revised Handb. Flora Ceylon 9 (in press)

Fig. 1 *Dipterocarpus glandulosus* Thw.

Fig. 1*a* *Dipterocarpus glandulosus* Thw.

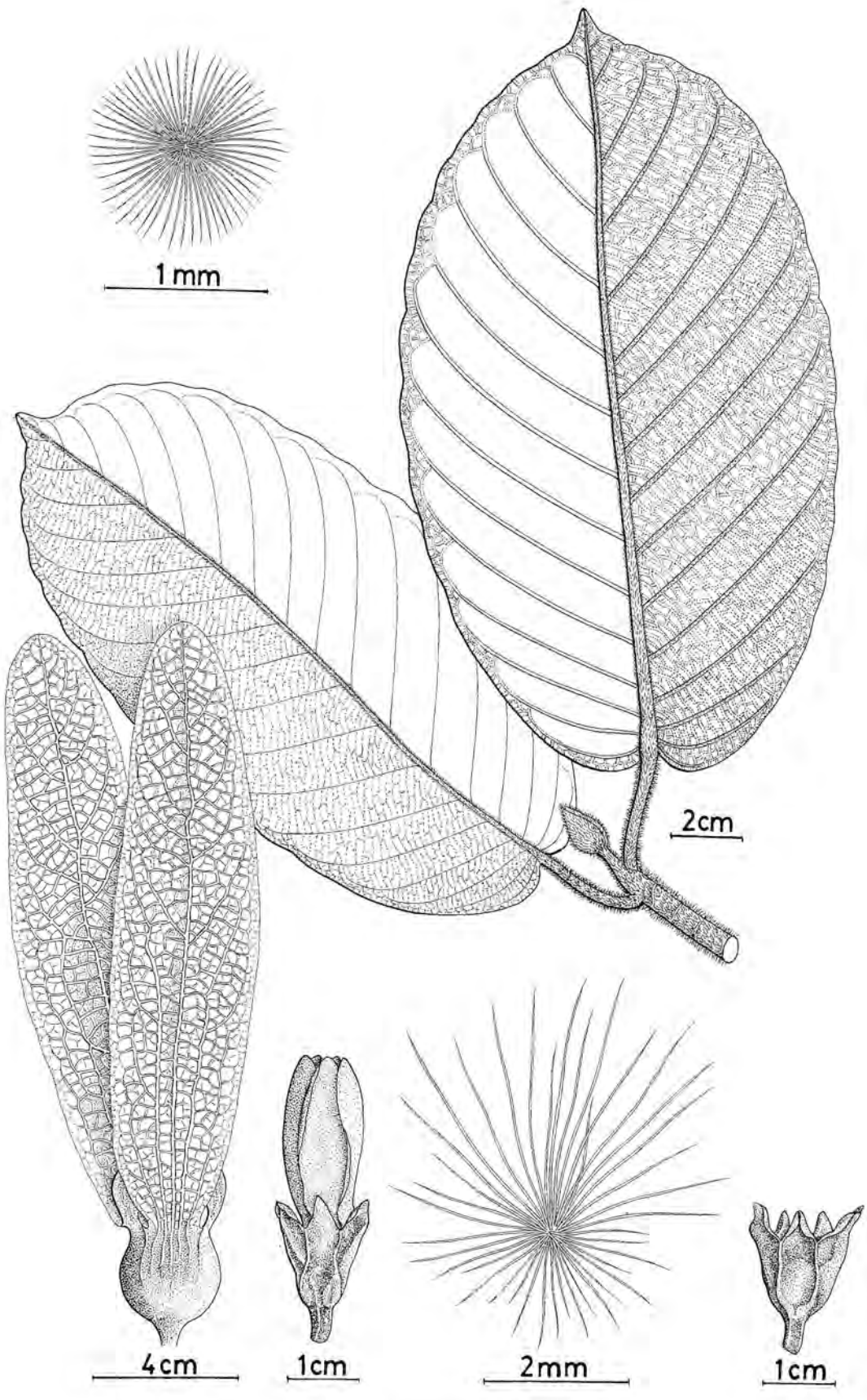

Fig. 2 *Dipterocarpus hispidus* Thw.

Fig. 2*a* *Dipterocarpus hispidus* Thw.

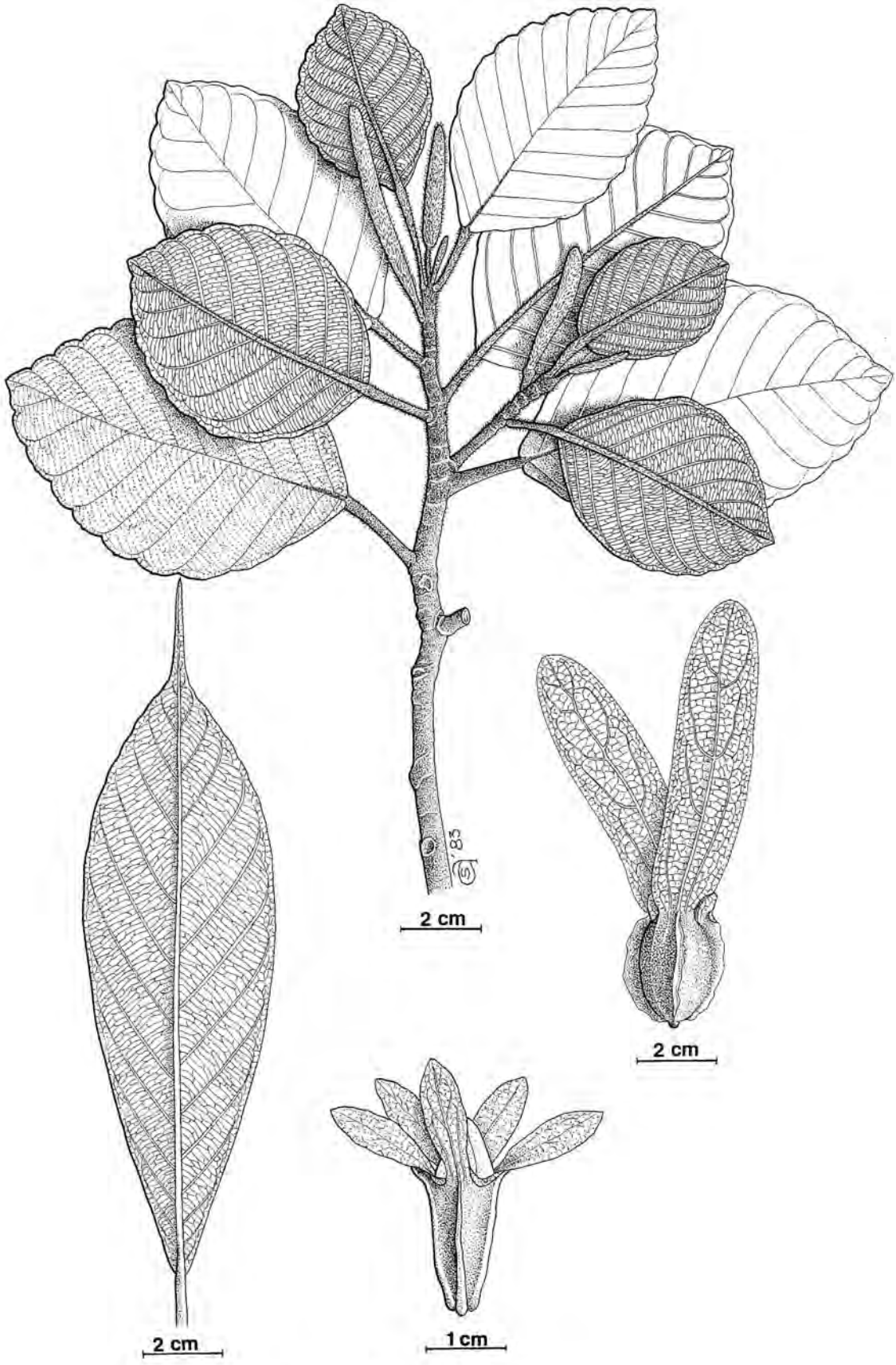

Fig. 3 *Dipterocarpus insignis* Thw.

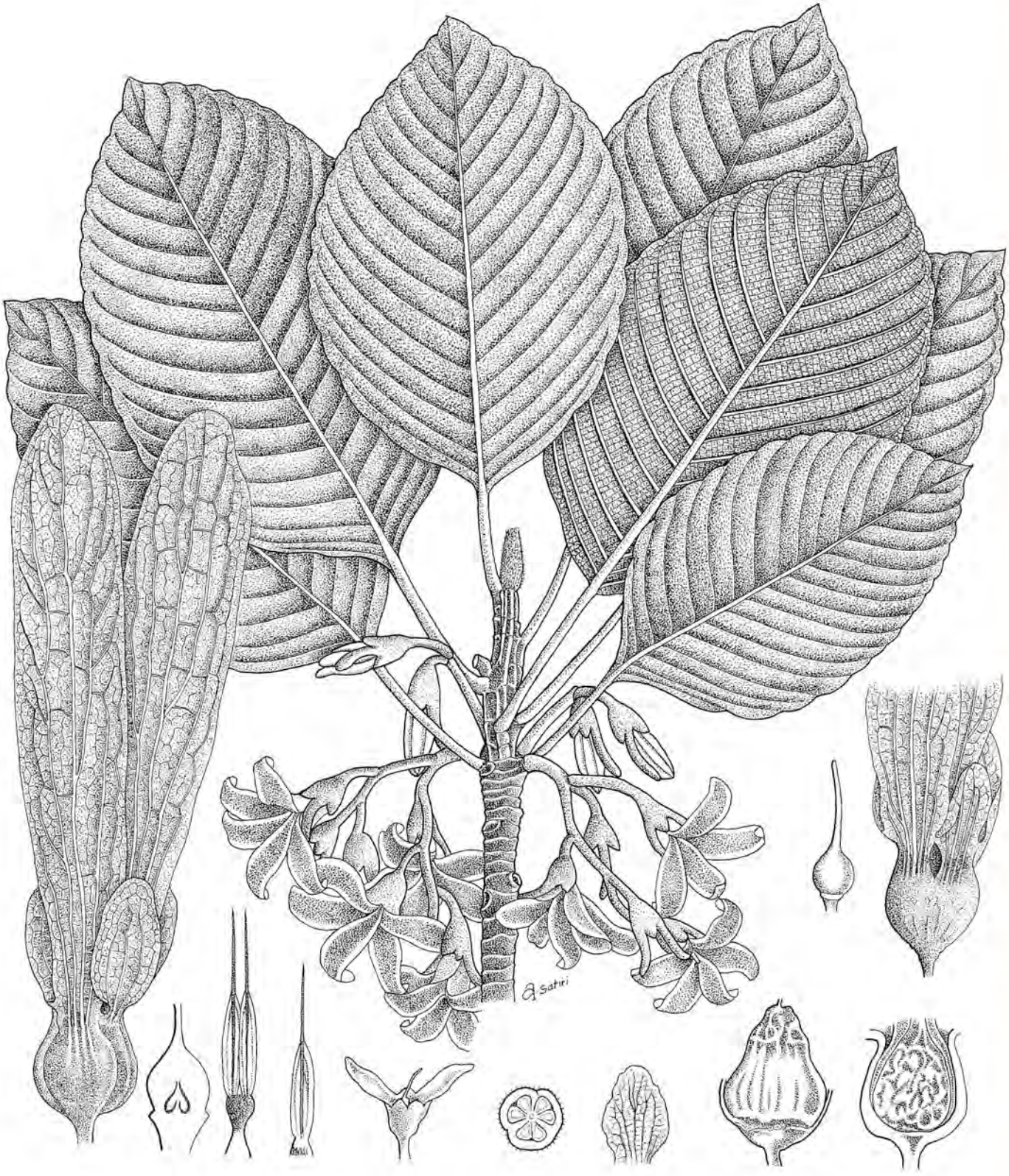

Fig. 4 *Dipterocarpus zeylanicus* Thw.

Fig. 4*a* *Dipterocarpus zeylanicus* Thw.

Fig. 4*b* *Dipterocarpus zeylanicus* Thw.
Sinharaja forest, Sri Lanka.

Fig. 5 *Sunaptea scabriuscula* (Thw.) Trim.

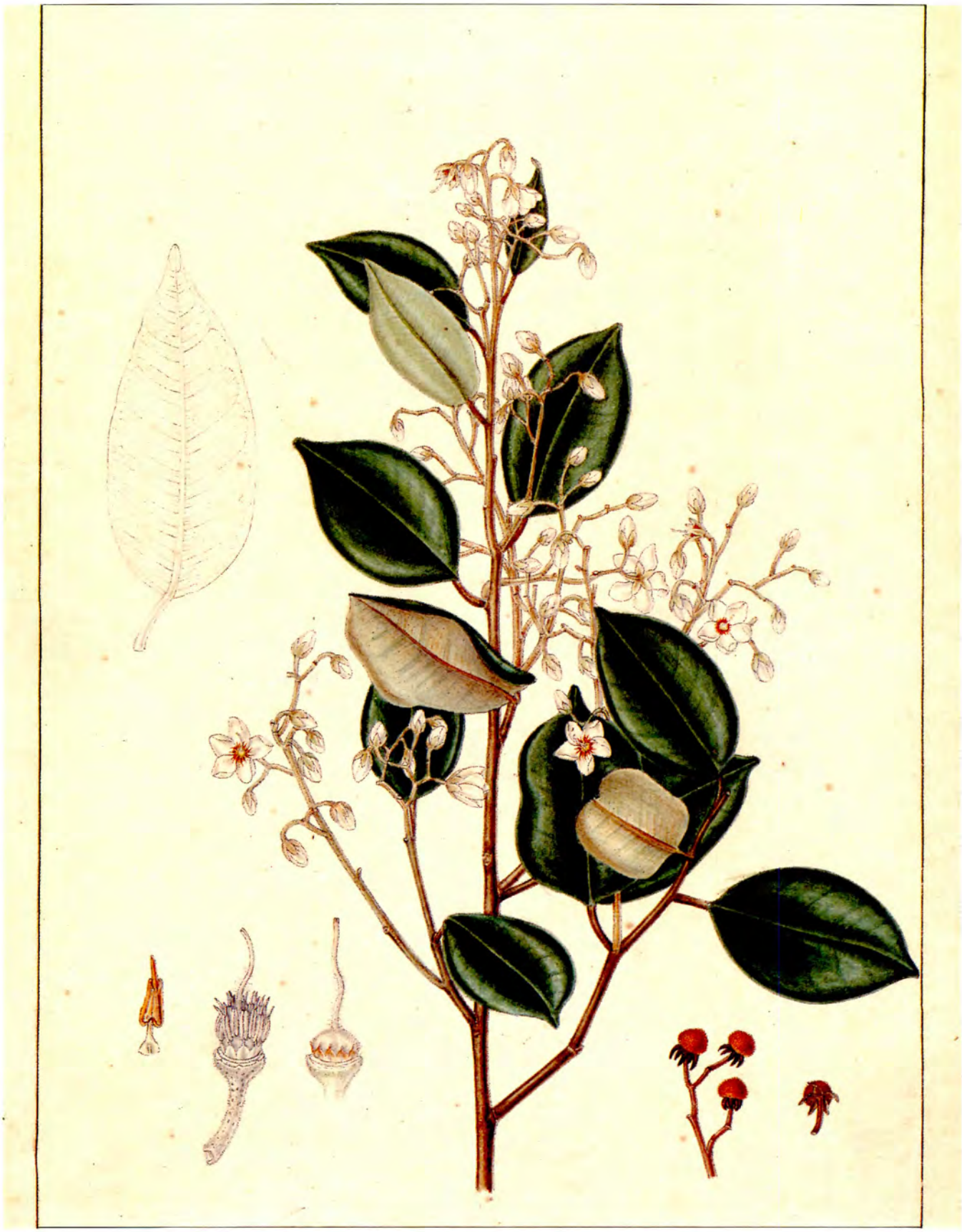

Fig. 6 *Vatica lewisiana* (Thw. ex Hooker f.) Livera

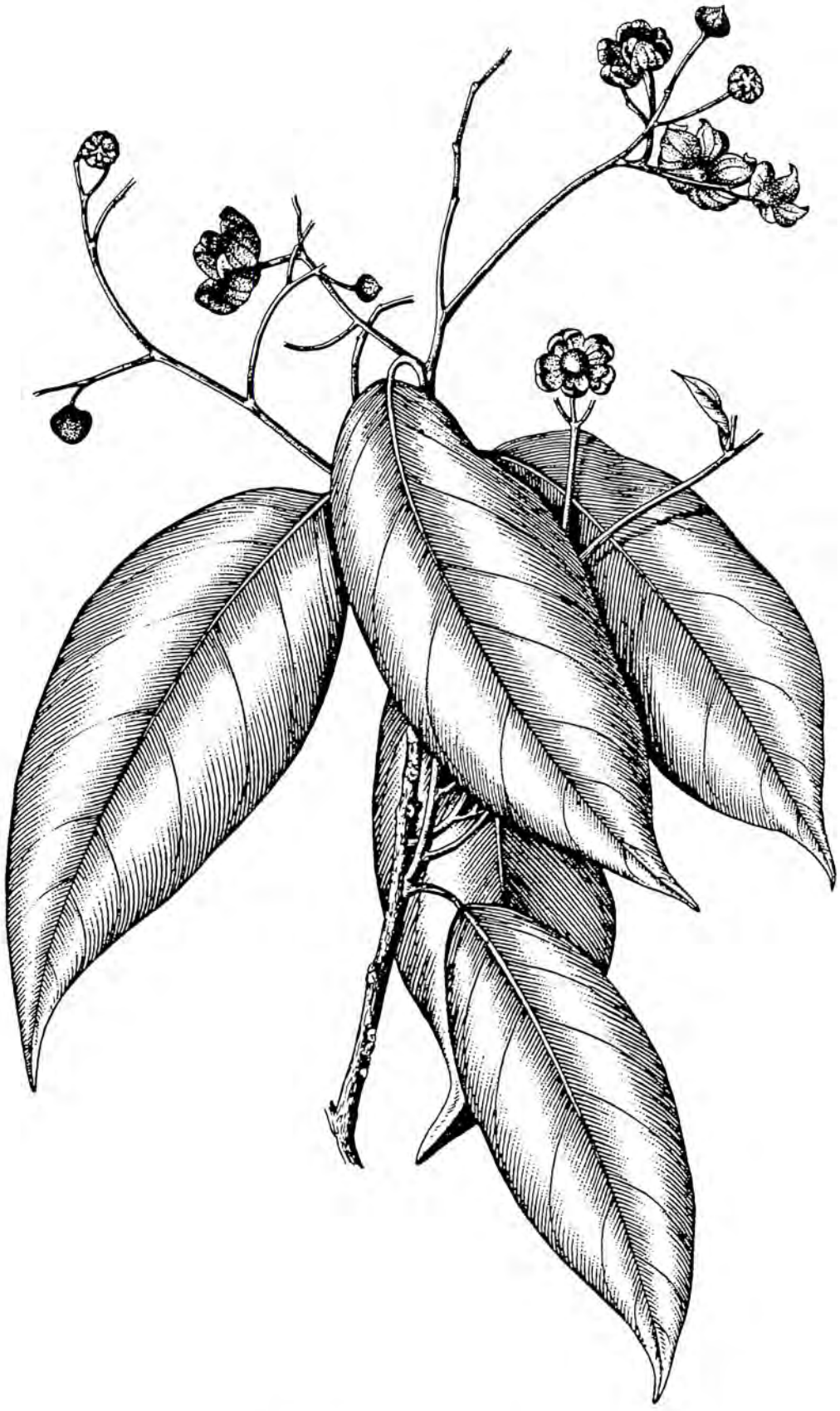

Fig. 7 *Vatica affinis* Thw.

Fig. *7a Vatica affinis* Thw.

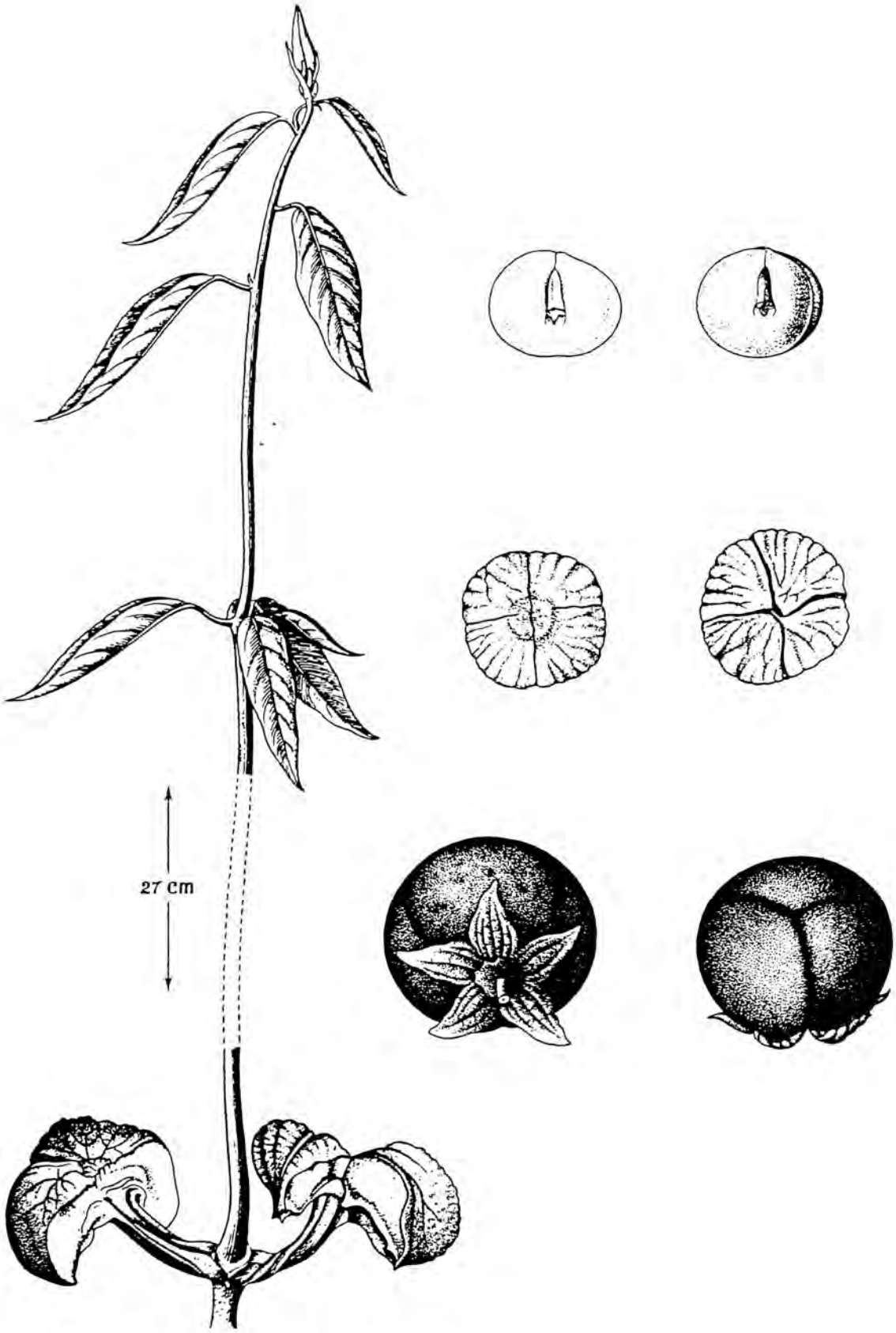

Fig. 8 *Vatica paludosa* Kosterm.

Fig. 8*a* *Vatica paludosa* Kosterm.

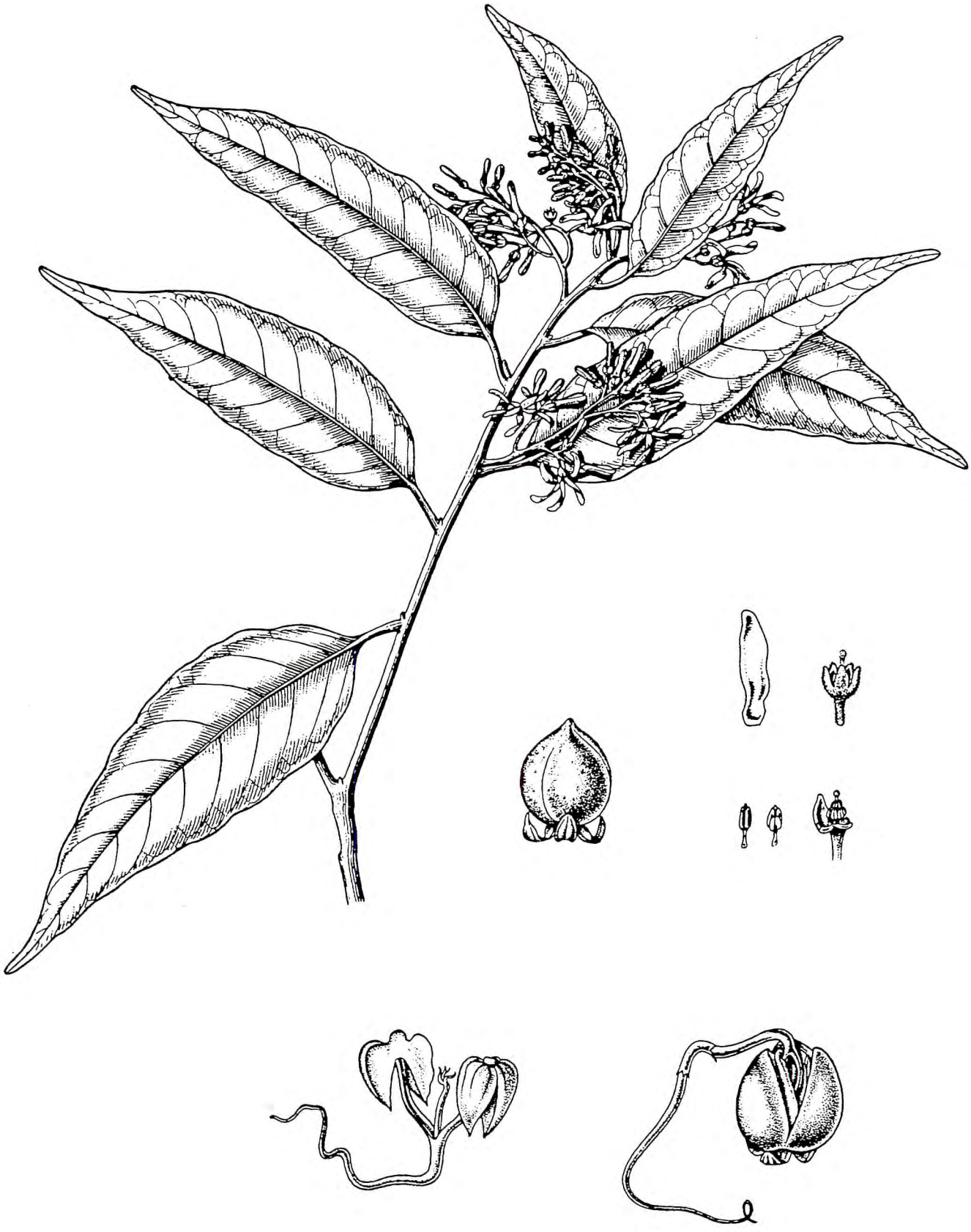

Fig. 9 *Vatica obscura* Trim.

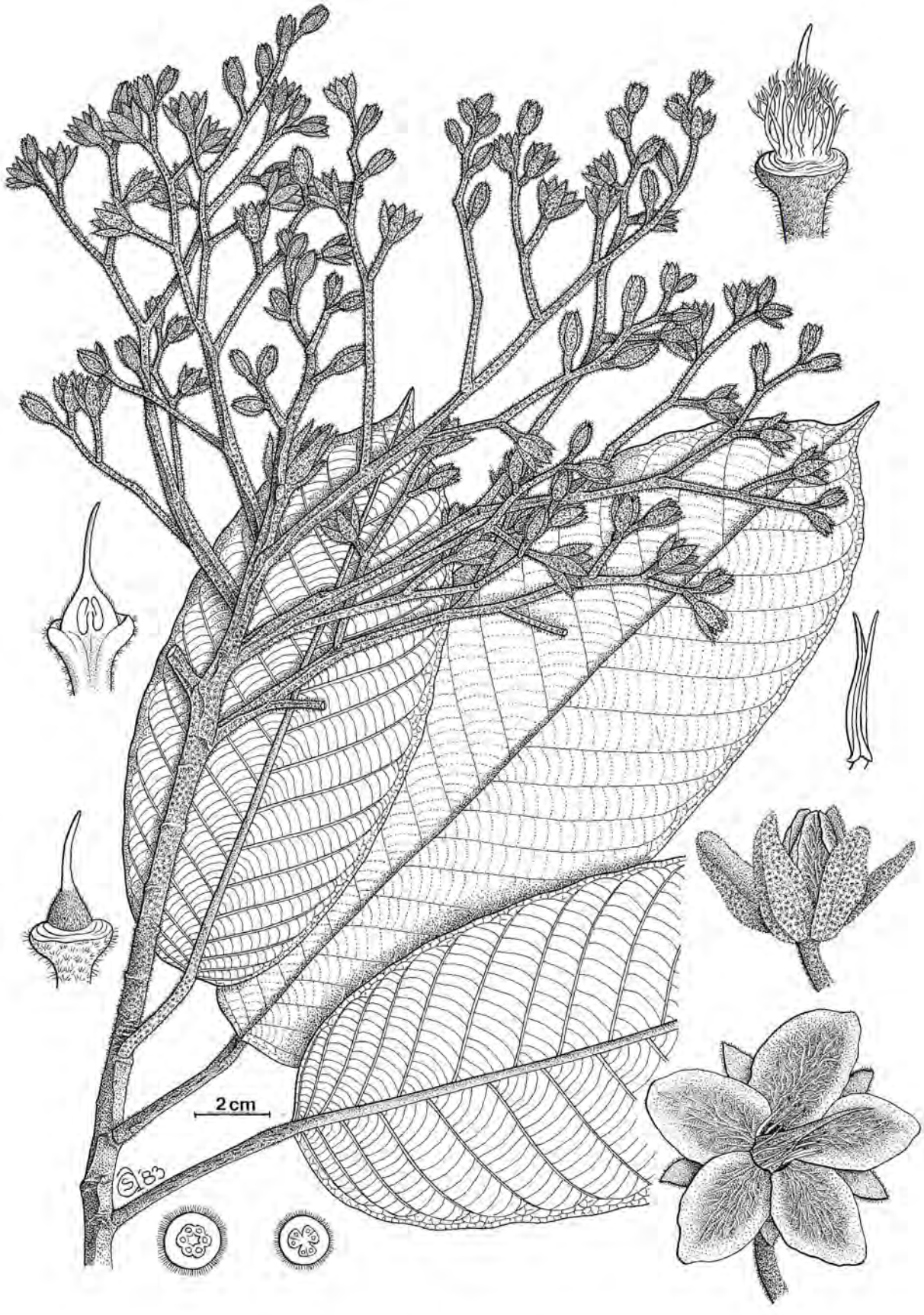

Fig. 10 *Vateria copallifera* (Retz.) Alston

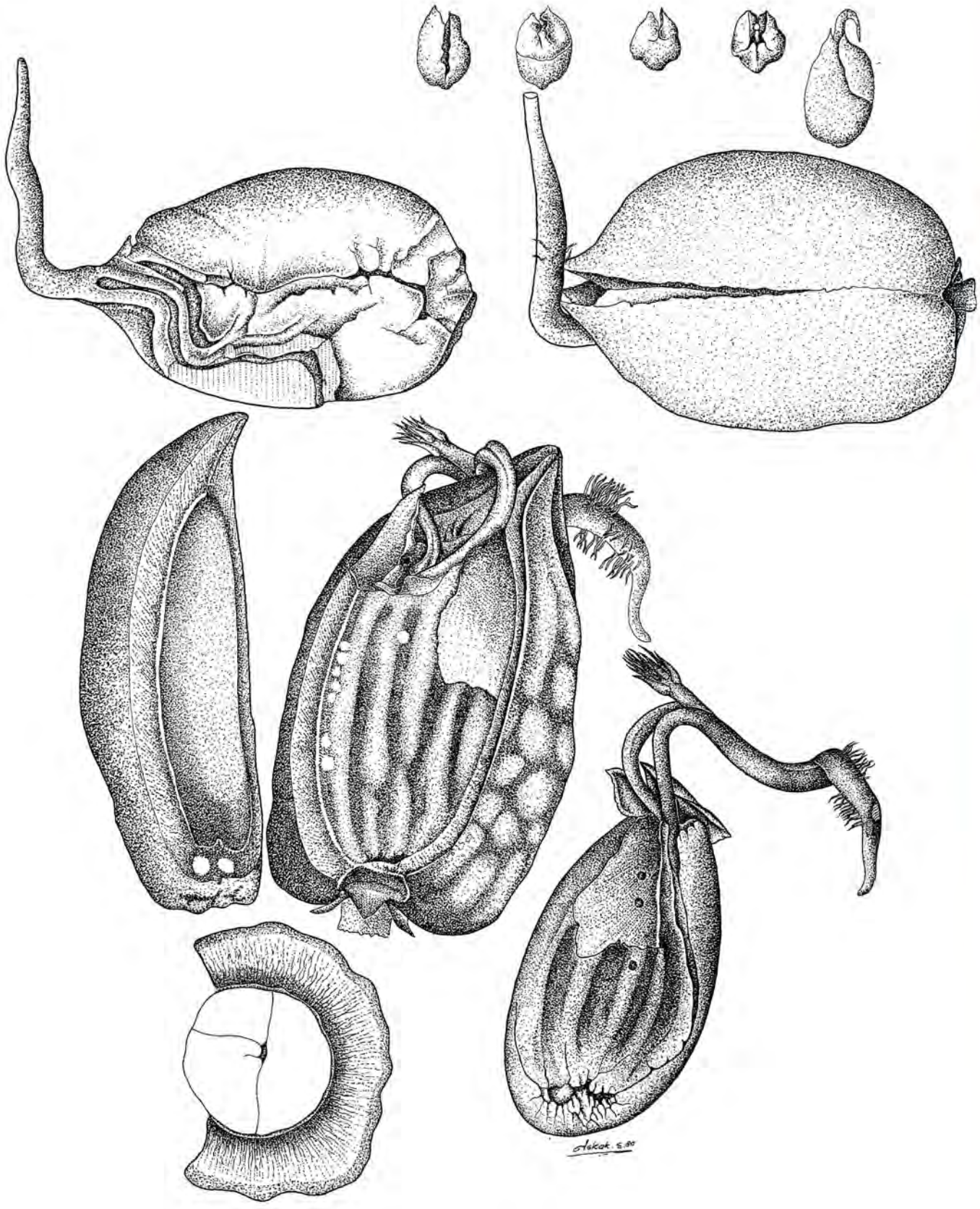

Fig. 11 *Vateria copallifera* (Retz.) Alston

Fig. 11*a* *Vateria copallifera* (Retz.) Alston.
Holo-typus of *Elaeocarpus copalliferus* Retz. (Lund)

Fig. 11*b* *Vateria copallifera* (Retz.) Alston

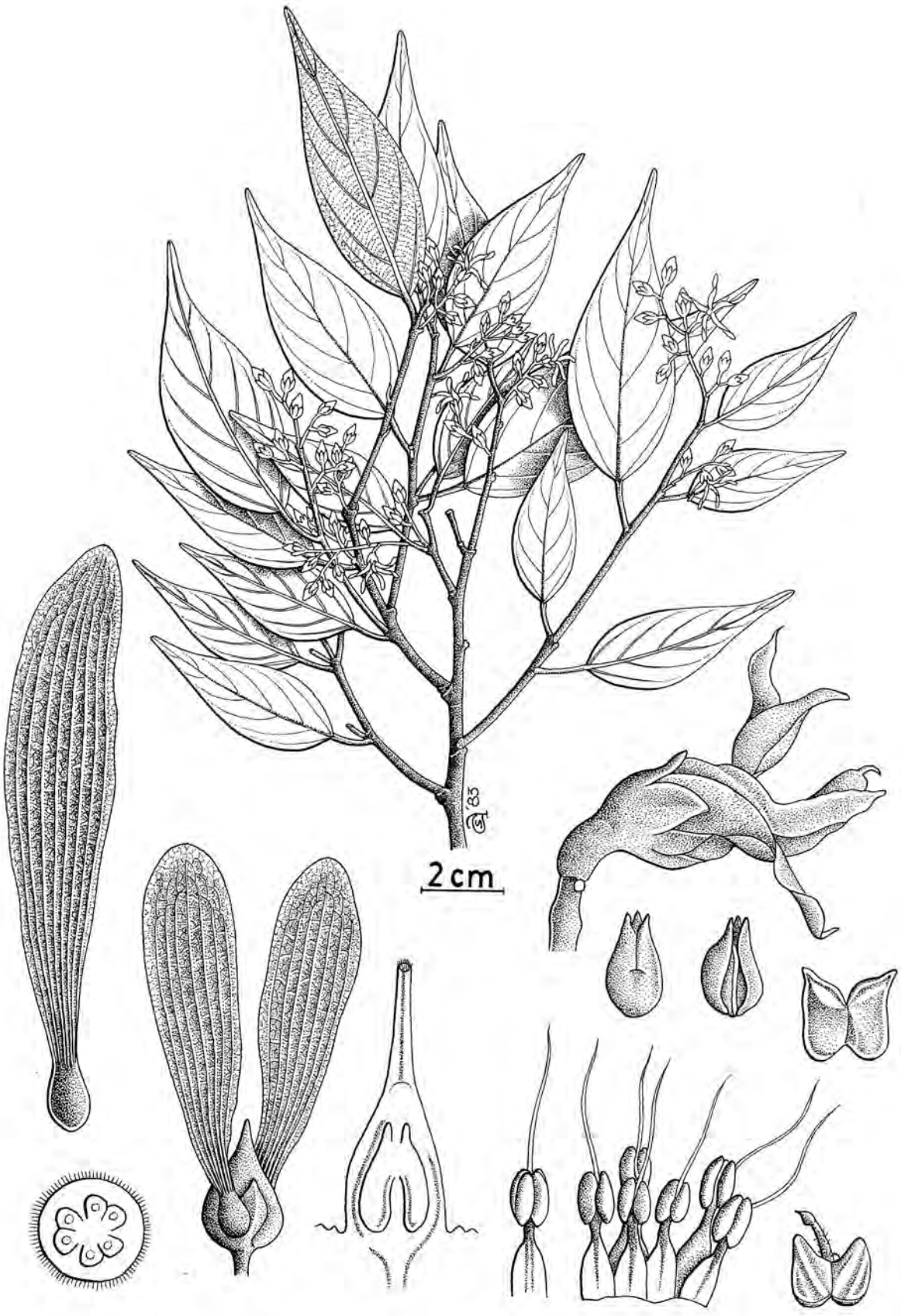

Fig. 12 *Hopea discolor* Thw.

Fig. 13 *Hopea cordifolia* (Thw.) Trim.

Fig. 14 *Hopea jucunda* Thw.

Fig. 14*a* *Hopea jucunda* Thw.

Fig. 14*b* *Hopea jucunda* Thw. Botanic Garden, Peradeniya.

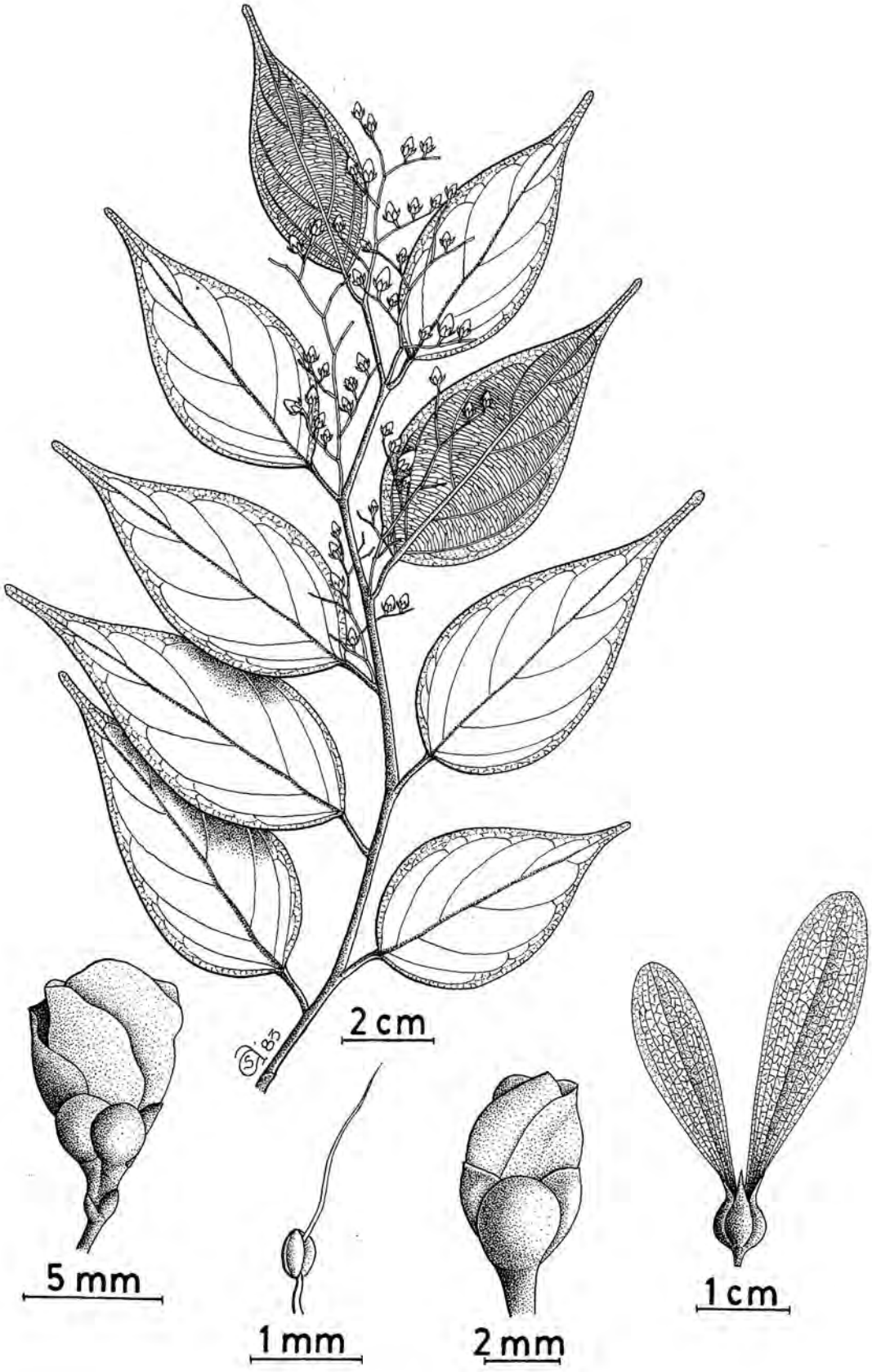

Fig. 15 *Hopea modesta* (DC) Kosterm.

Fig: 15*a* *Hopea modesta* (DC) Kosterm.

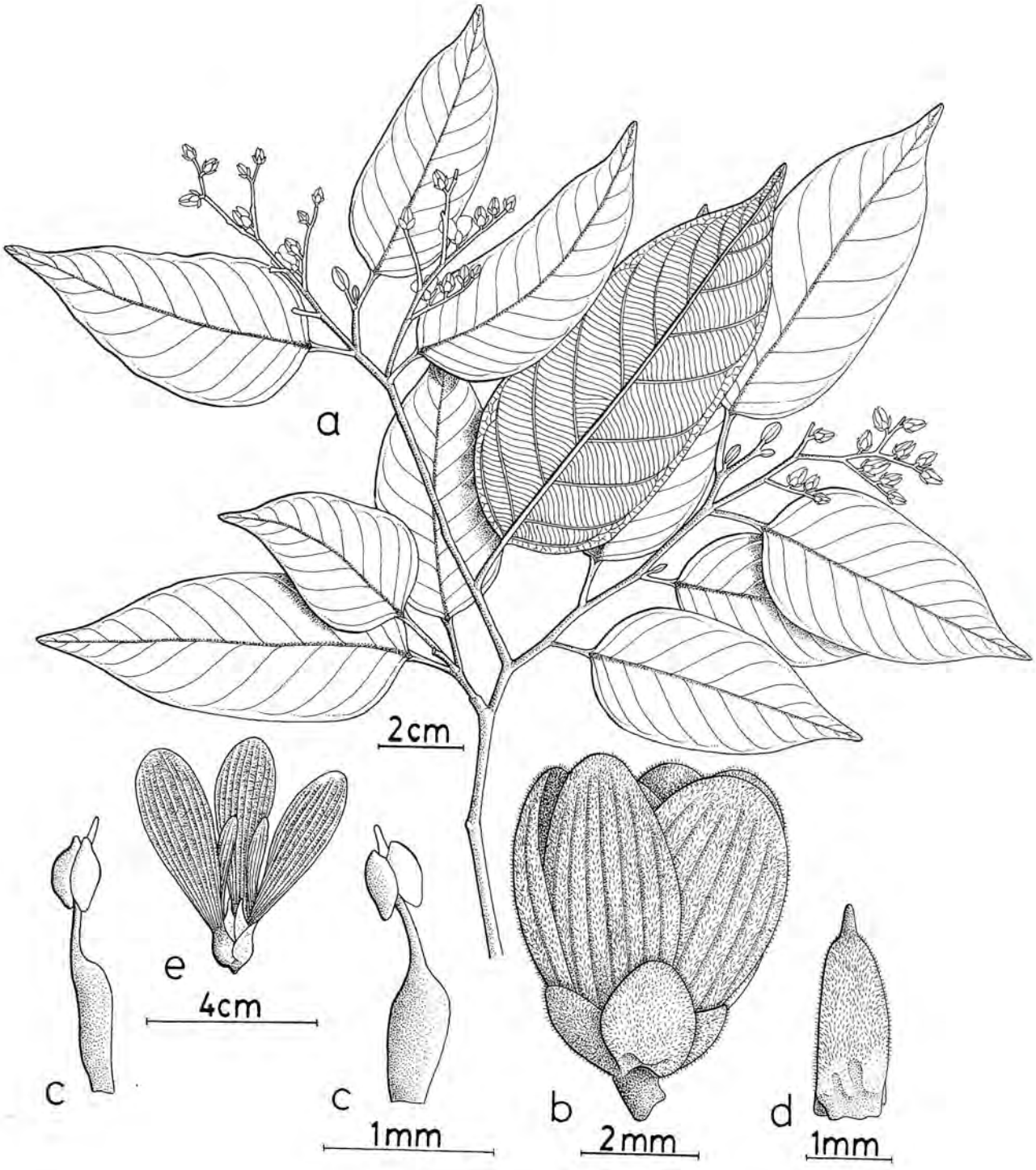

Fig. 16 *Shorea dyeri* Thw. (*a*) flowering branch; (*b*) flower; (*c*) stamen; (*d*) ovary; (*e*) fruit.

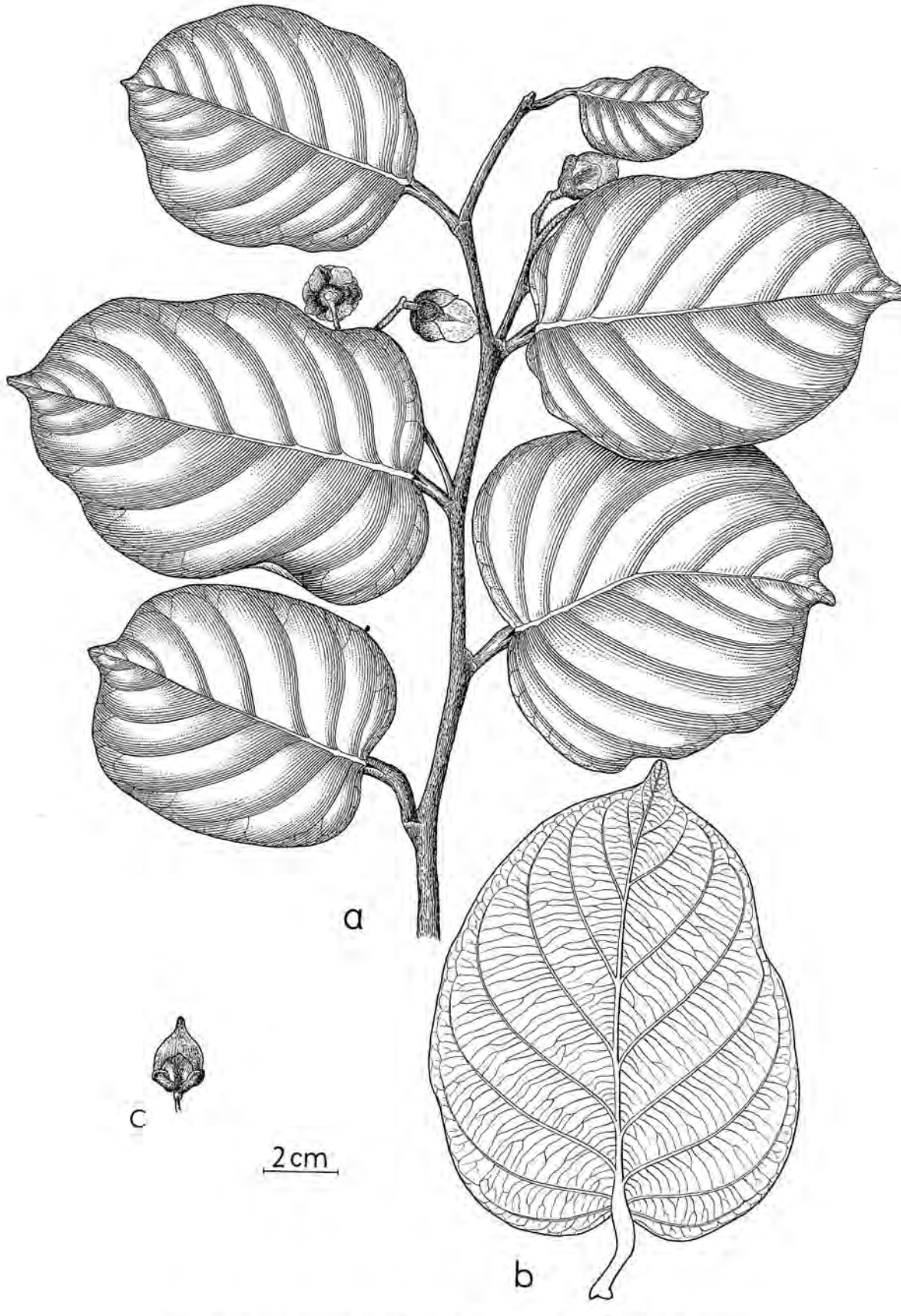

Fig. 17 *Shorea lissophylla* Thw. (*a*) flowering branch; (*b*) leaf; (*c*) fruit.

Fig. 17*a* *Shorea lissophylla* Thw.

Fig. 17*b* *Shorea lissophylla* Thw.

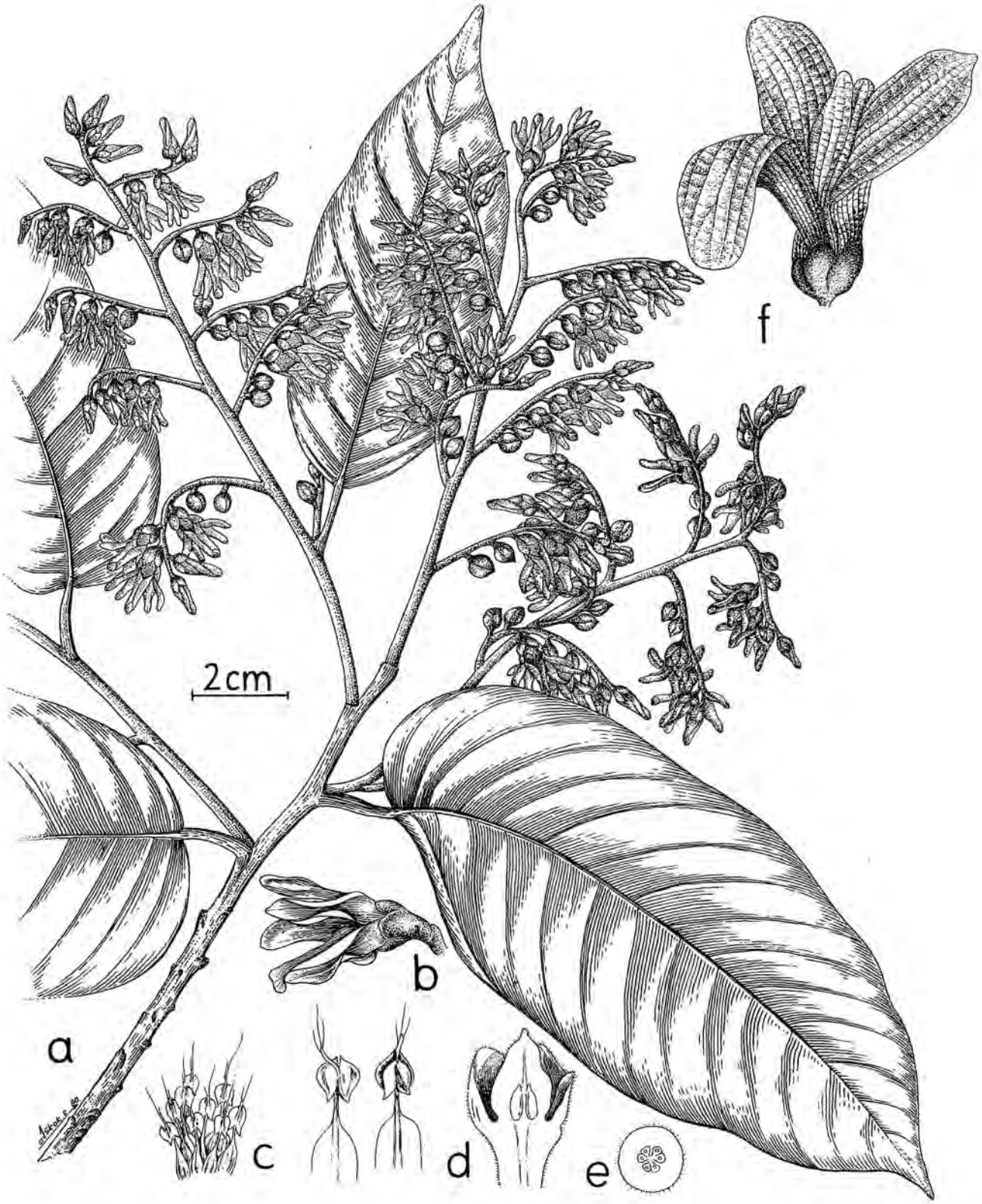

Fig. 18 *Shorea oblongifolia* Thw. (*a*) flowering branch; (*b*) flower; (*c*) stamens; (*d*) cross-section flower; (*e*) idem ovary; (*f*) fruit.

Fig. 18*a* *Shorea oblongifolia* Thw.

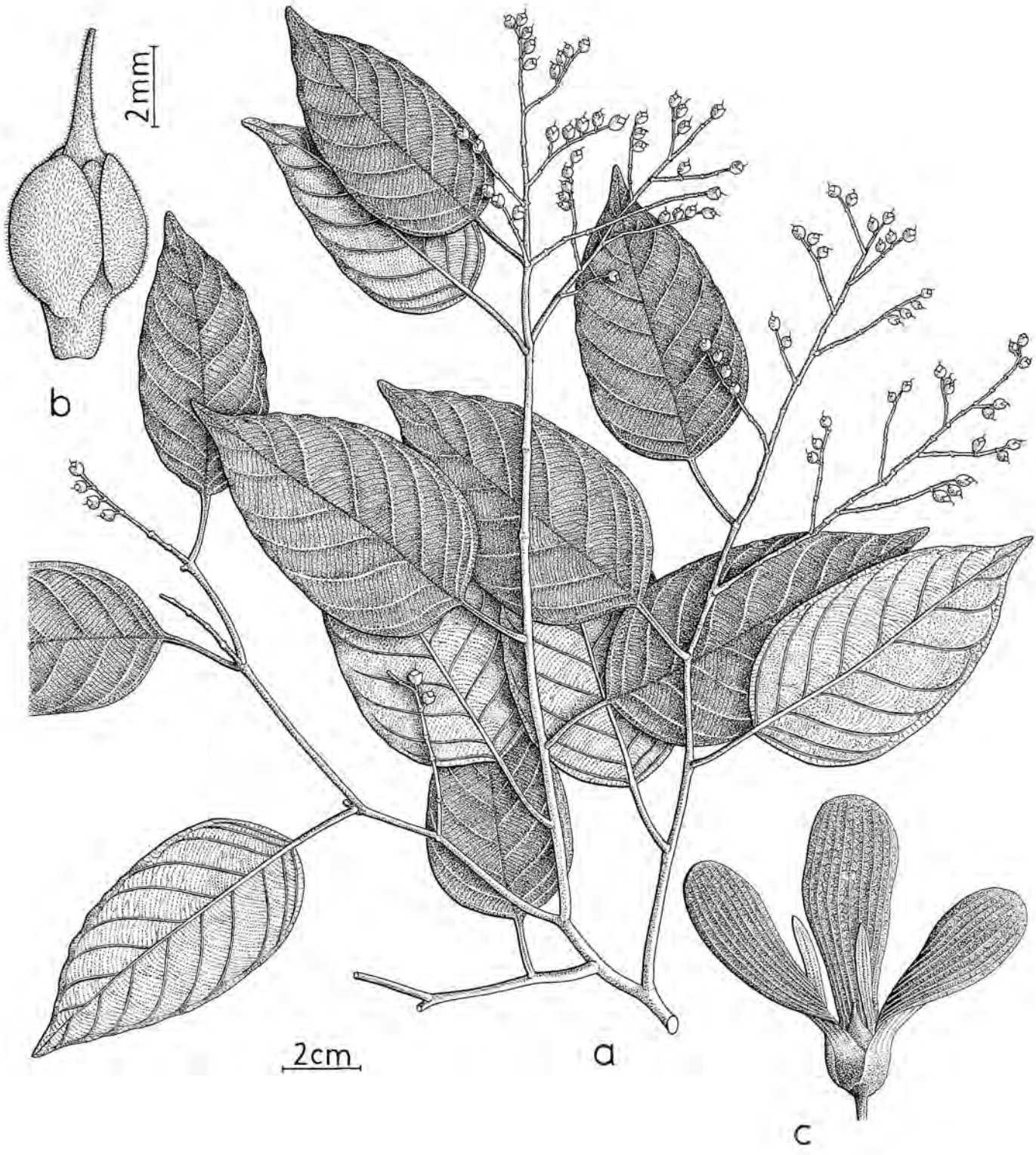

Fig. 19 *Shorea pallescens* Ashton. (*a*) flowering branch; (*b*) ovary; (*c*) fruit.

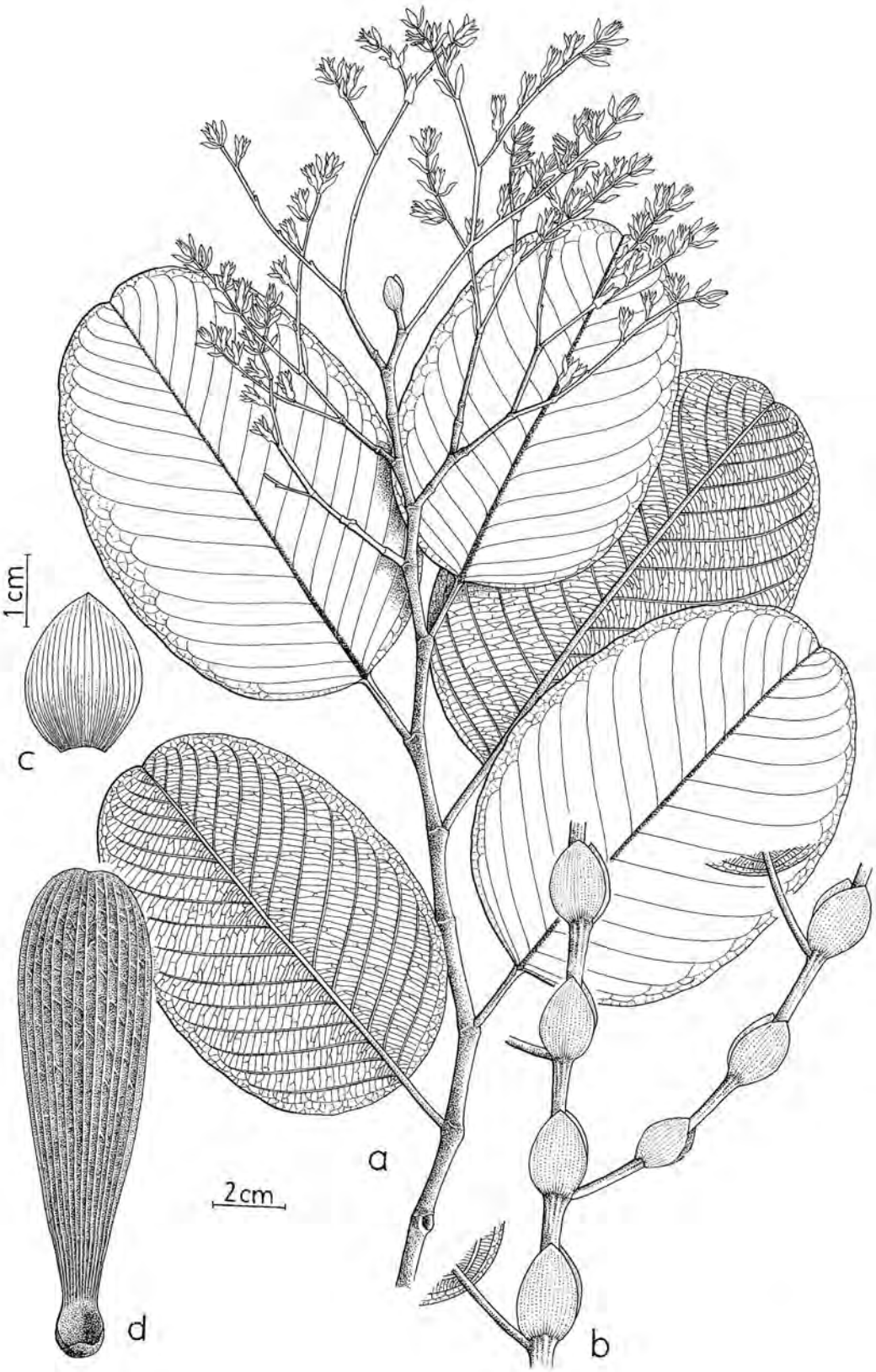

Fig. 20 *Shorea stipularis* Thw. (*a*) flowering branch; (*b*) stipules; (*c*) stipule; (*d*) fruit.

Fig. 20*a* *Shorea stipularis* Thw.

Fig. 21 *Shorea hulanidda* Kosterm. (*a*) flowering branch; (*b*) flower; (*c*) stamens; (*d*) fruit.

Fig. 21*a* *Shorea hulanidda* Kosterm.

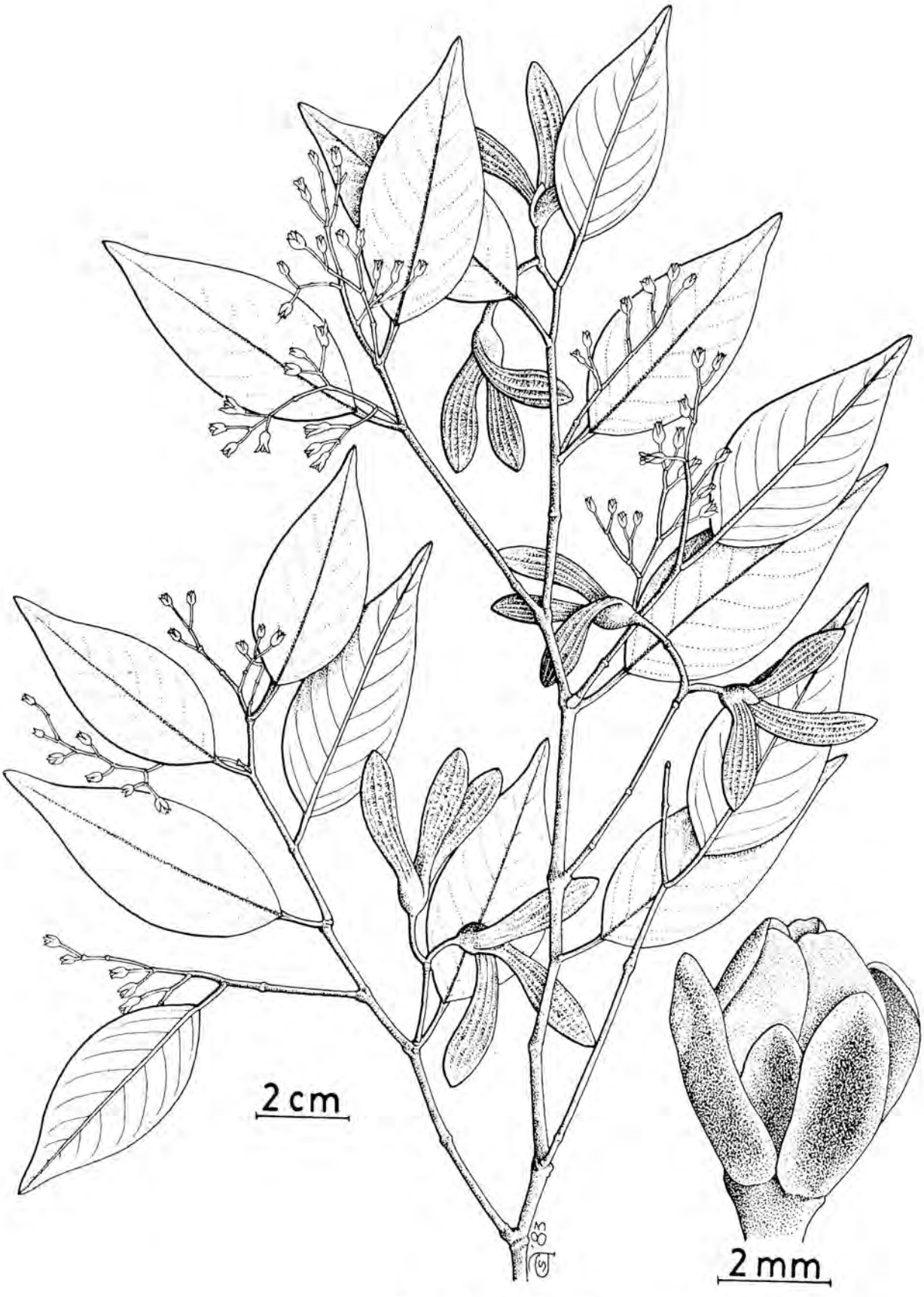

Fig. 22 *Doona affinis* Thw.

Fig. 22*a* *Doona affinis* Thw. After Alston 2027 (PDA)

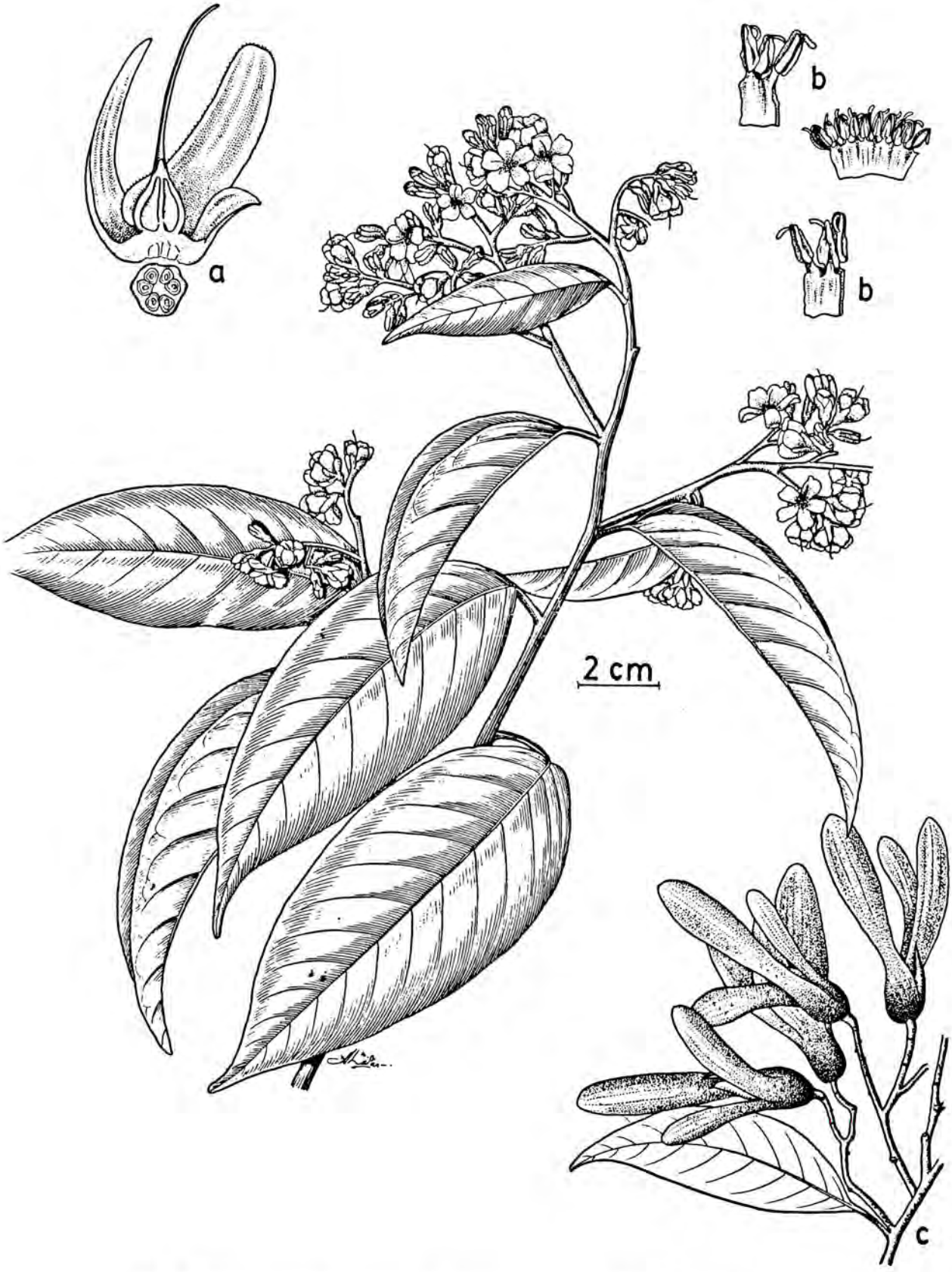

Fig. 23 *Doona congestiflora* Thw. (*a*) cross-section flower; (*b*) flower; (*c*) flowering branch.

Fig. 24 *Doona gardneri* Thw. Flower, fruit and stamen after Beddome. (*a*) flower; (*b*) fruit; (*c*) stamens; (*d*) section nut; (*e*) cross-section nut; (*f*) top of nut.

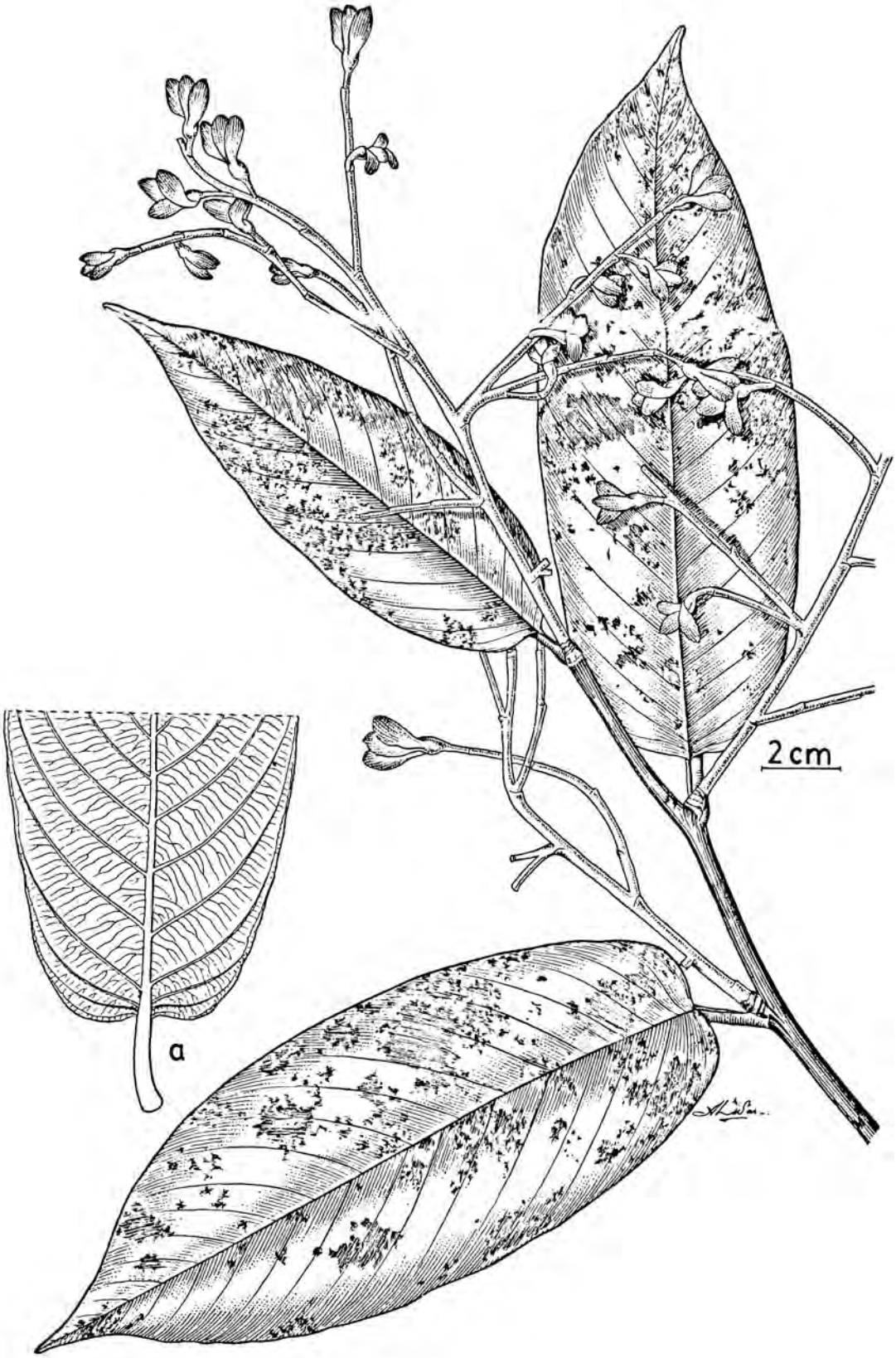

Fig. 25 *Doona macrophylla* Thw. (*a*) nerves of the lower leaf surface.

Fig. 25*a* *Doona macrophylla* Thw.

Fig. 25*b* *Doona macrophylla* Thw.

Fig. 26 *Doona nervosa* Thw. (*a*) gall.

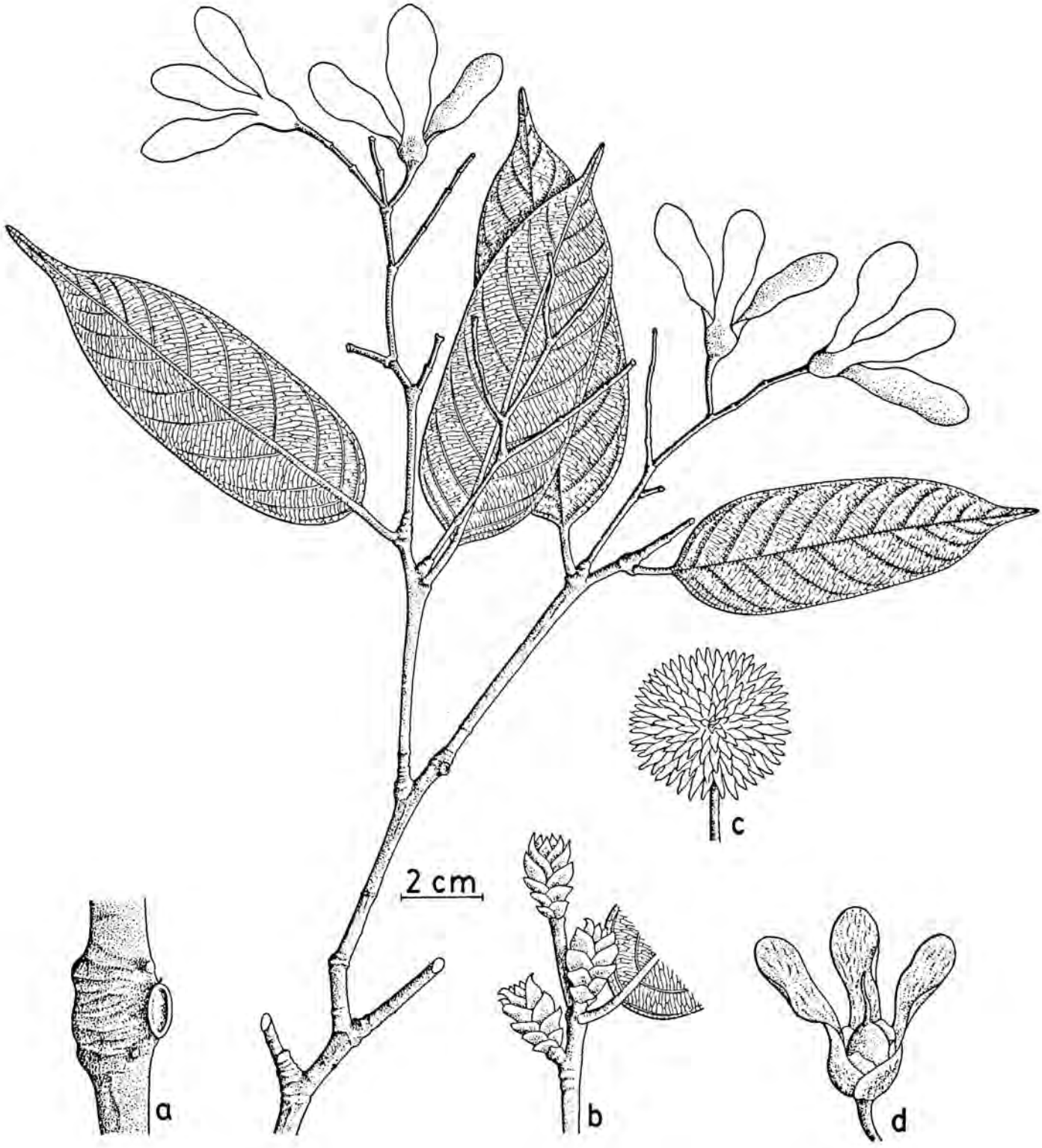

Fig. 27 *Doona oblonga* Thw. (*a*) collar of scars; (*b*) bud scales; (*c*) gall; (*d*) fruit.

Fig. 27*a* *Doona oblonga* Thw.

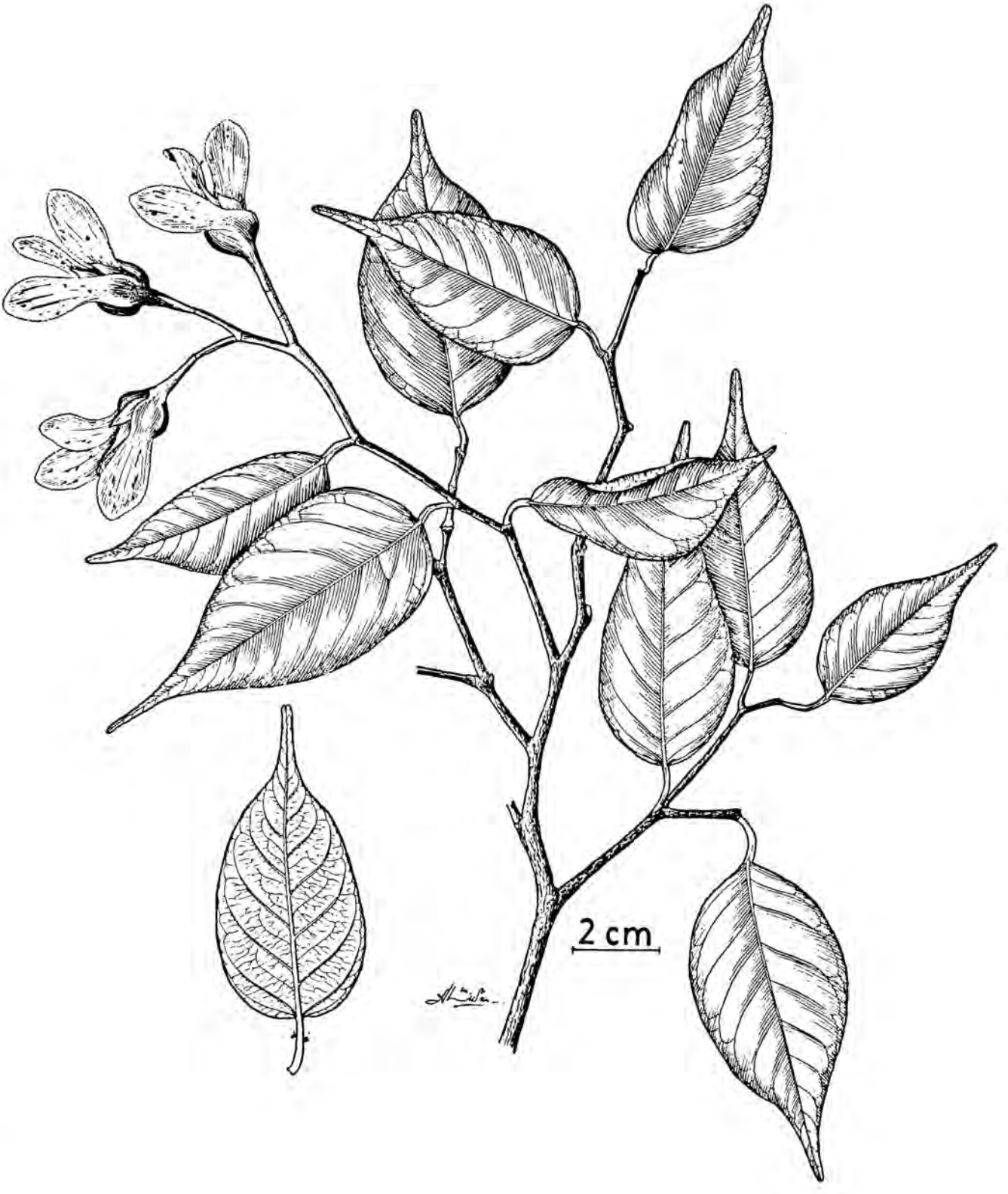

Fig. 28 *Doona ovalifolia* Thw.

Fig. 28*a* *Doona ovalifolia* Thw.

Fig. 28*b* *Doona ovalifolia* Thw.

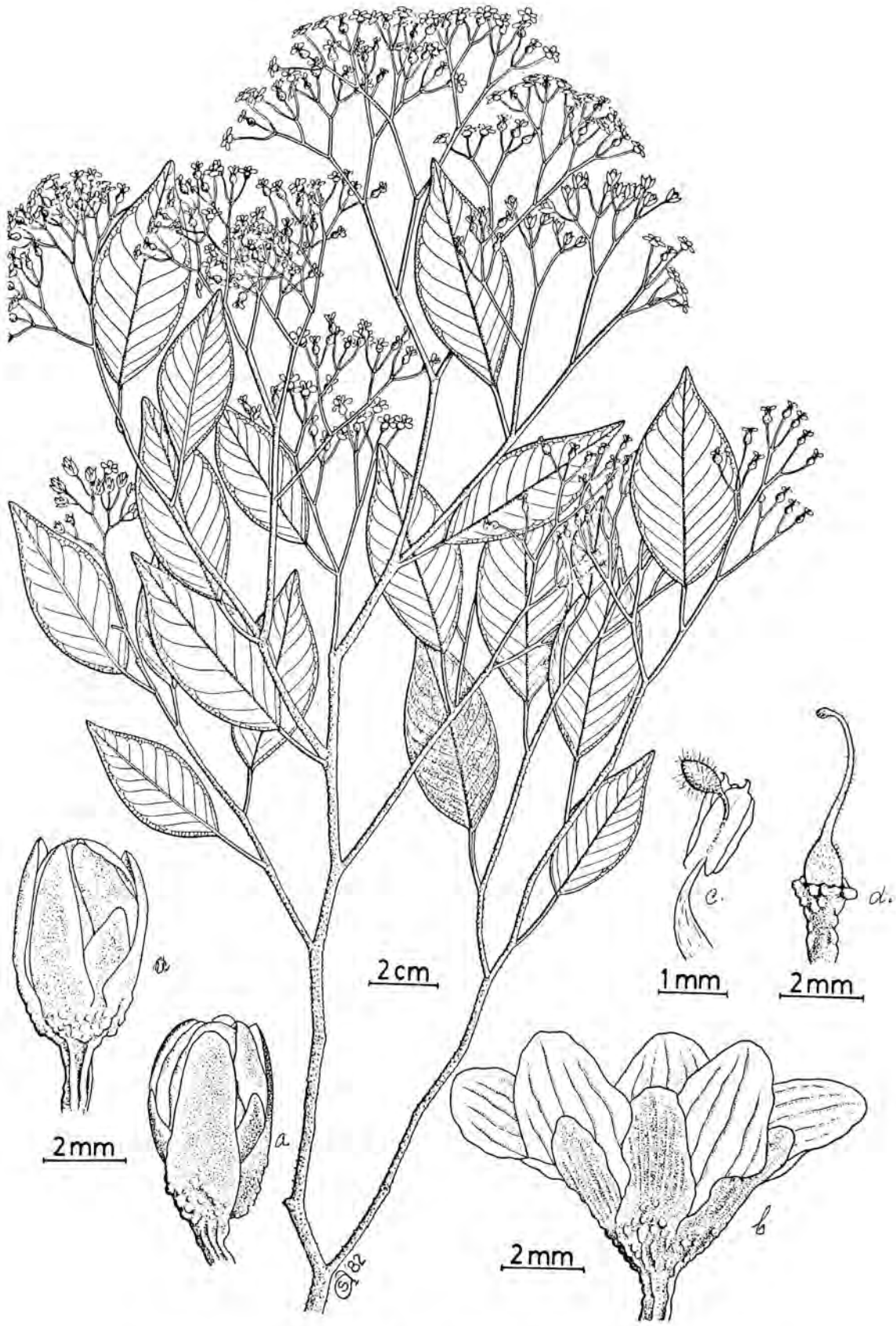

Fig. 29 *Doona trapezifolia* Thw. (*a*) flower bud; (*b*) flower; (*c*) stamen; (*d*) ovary.

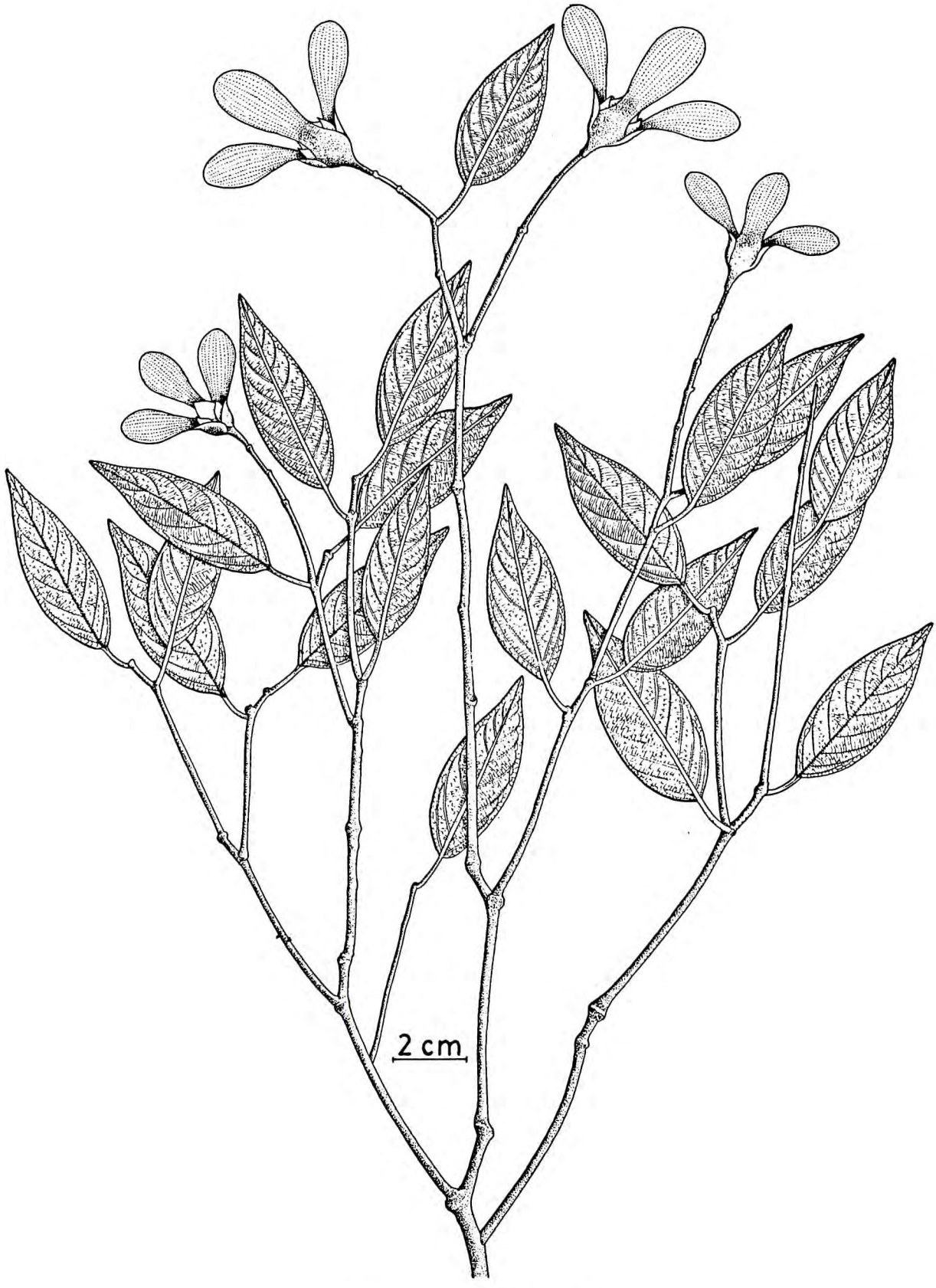

Fig. 30 *Doona venulosa* Thw.

Fig. 31 *Doona zeylanica* Thw. Flower, fruit and stamen after Beddome. (*a*) fruit; (*b*) flower; (*c*) ovary natural side and enlarged; (*d*) ovule; (*e*) cross-section ovary; (*f*) stamens; (*g*) developing inflorescences; (*h*) petal.

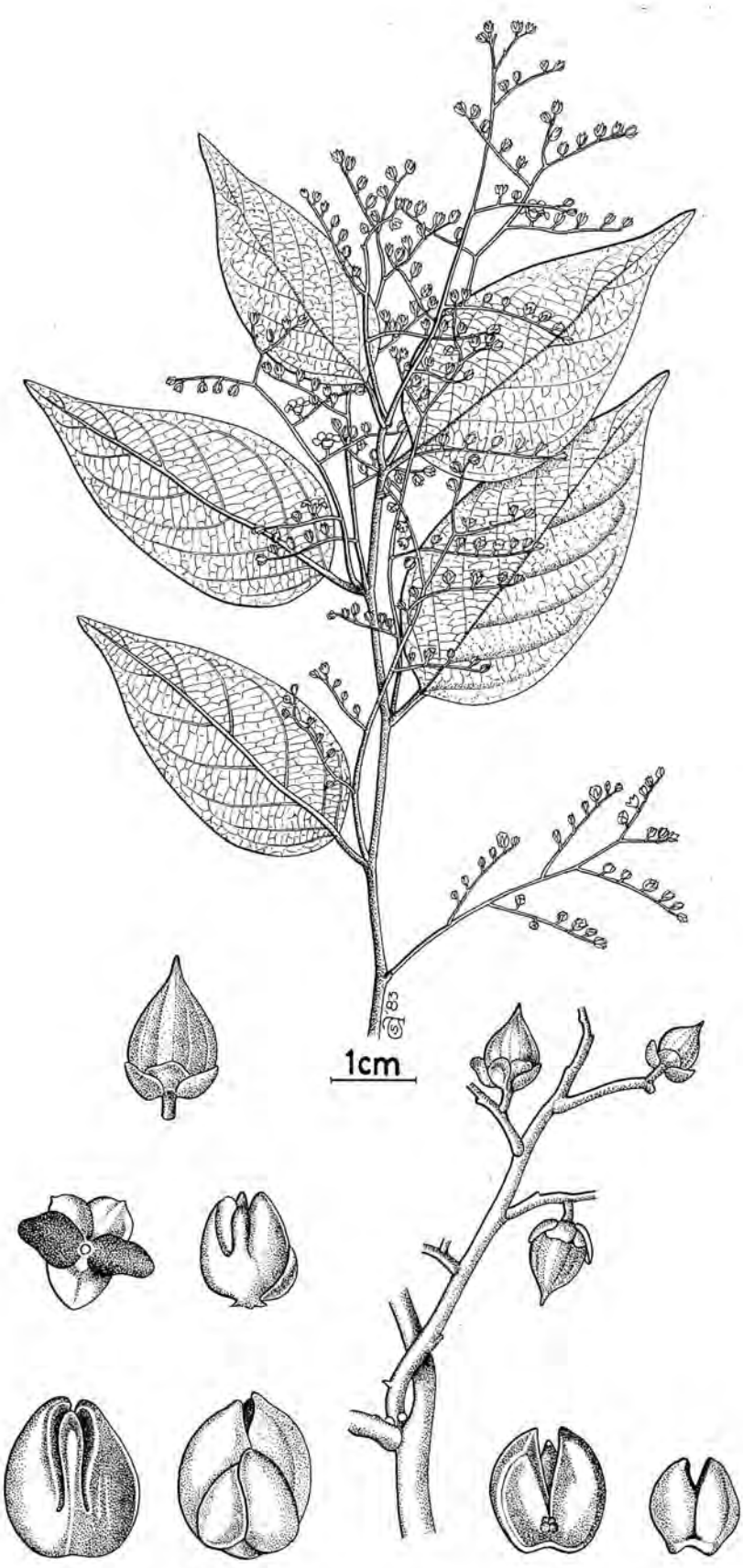

Fig. 32 *Balanocarpus brevipetiolaris* (Thw.) Alston

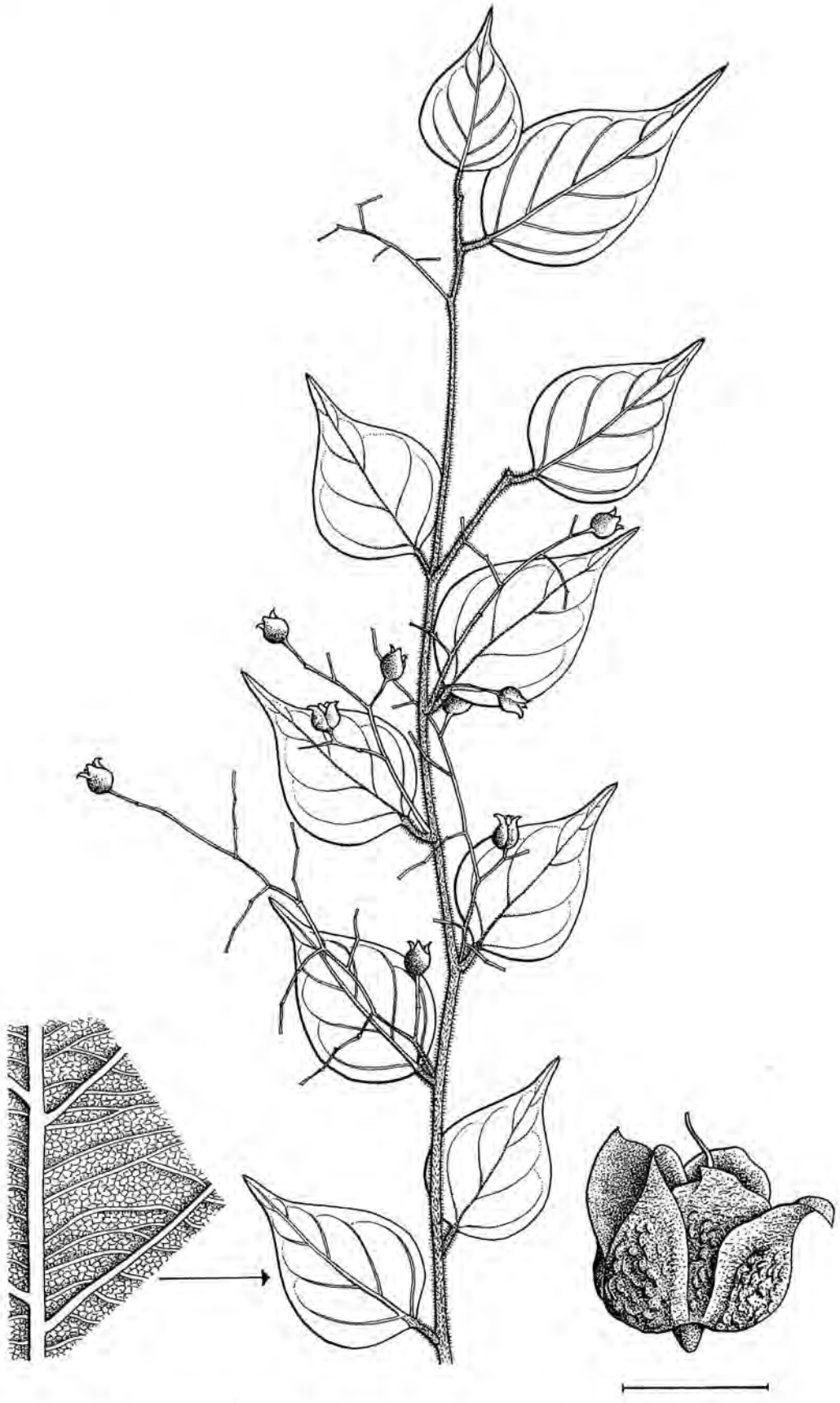

Fig. 33 *Balanocarpus kitulgallensis* Kosterm. After isotype (Bo).

Fig. 34 *Stemonoporus lancifolius* (Thw.) Alston

Fig. 35 Sinharaja forest, Sri Lanka.

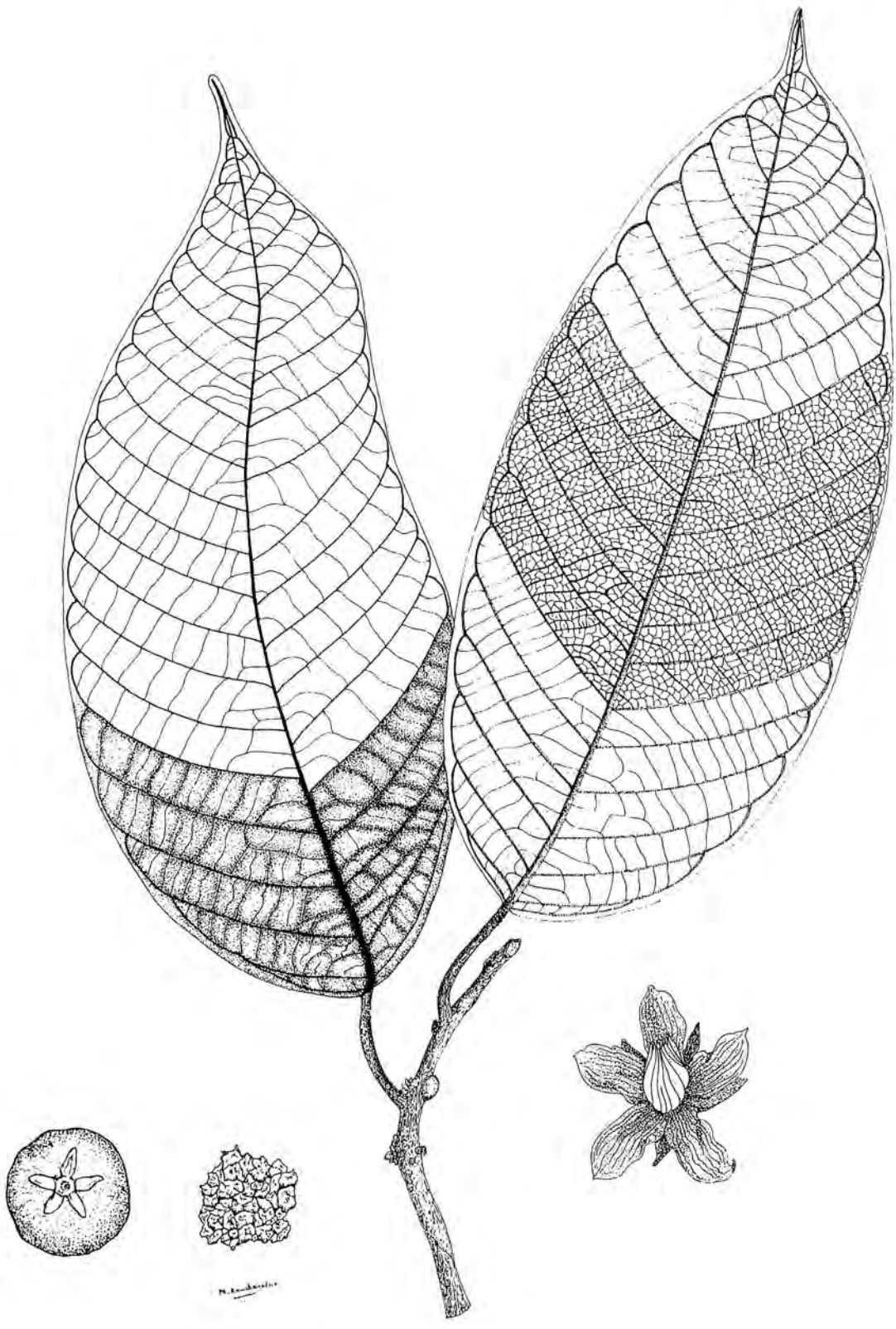

Fig. 36 *Stemonoporus bullatus* Kosterm. Fruit from below, texture of fruit and flower. After Balasubramaniam.

Fig. 36*a* *Stemonoporus bullatus* Kosterm.

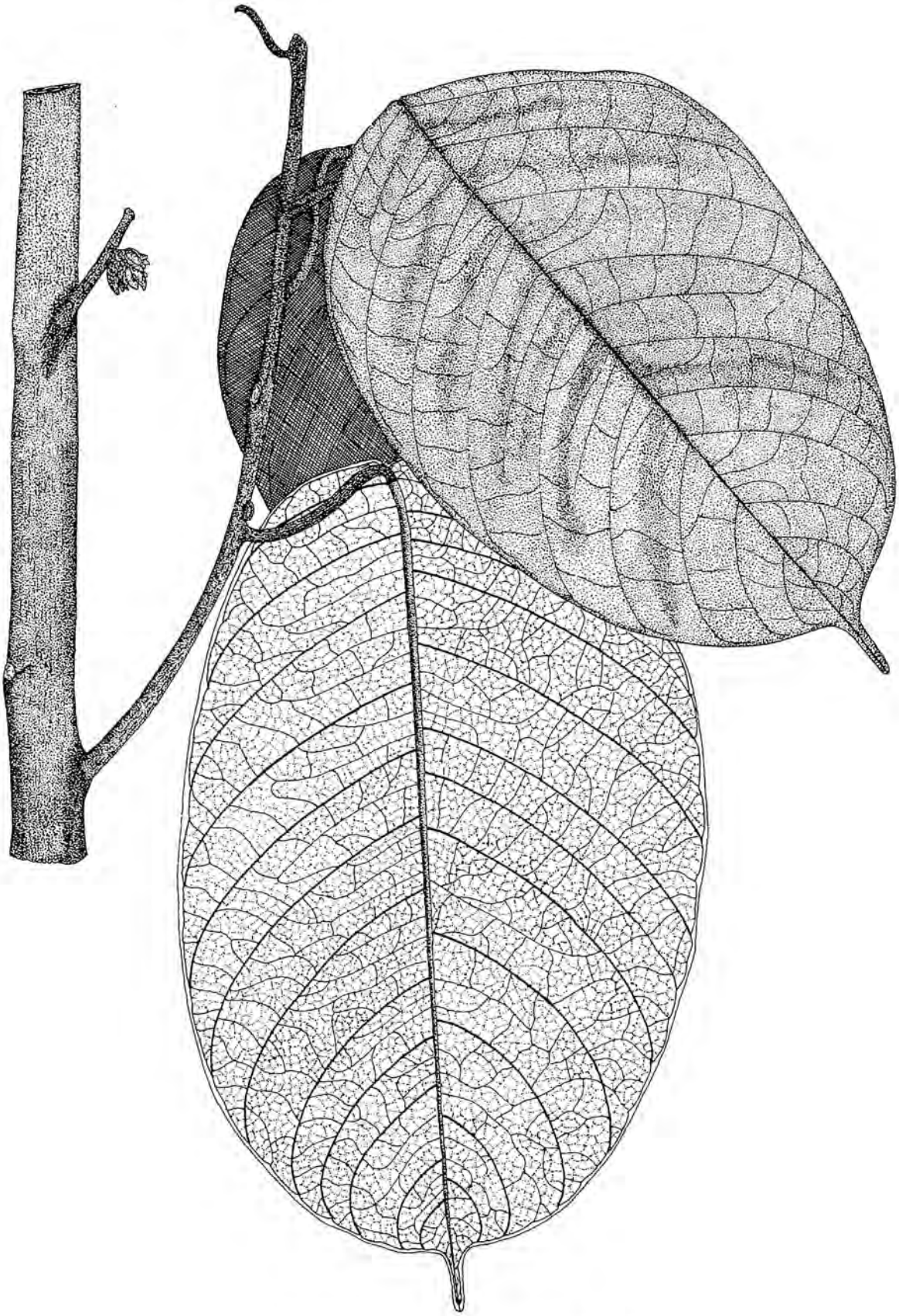

Fig. 37 *Stemonoporus kanneliyensis* Kosterm.

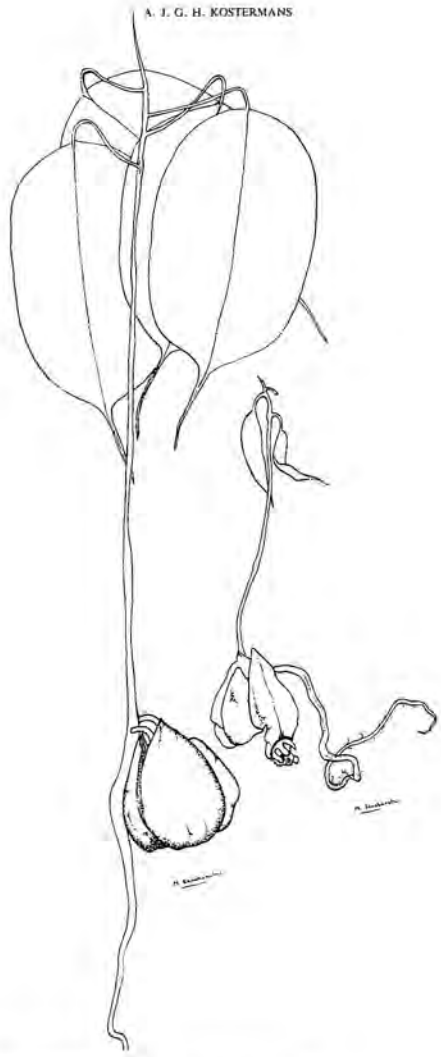

Fig. 37*a* Seedling of *Stemonoporus kanneliyensis* Kosterm.

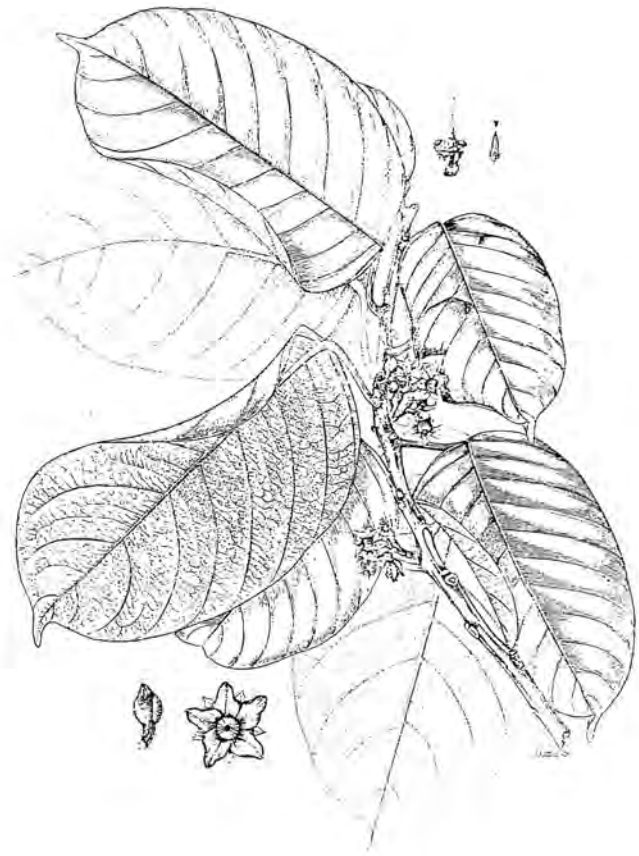

Fig. 37*b* *Stemonoporus kanneliyensis* Kosterm.

Fig. 38 *Stemonoporus revolutus* Trim. ex Hooker f.

Fig. 39 *Stemonoporus gracilis* Kosterm.

Fig. 39*a* *Stemonoporus gracilis* Kosterm.

Fig. 40 *Stemonoporus gardneri* Thw.

Fig. 40*a* *Stemonoporus gardneri* Thw.

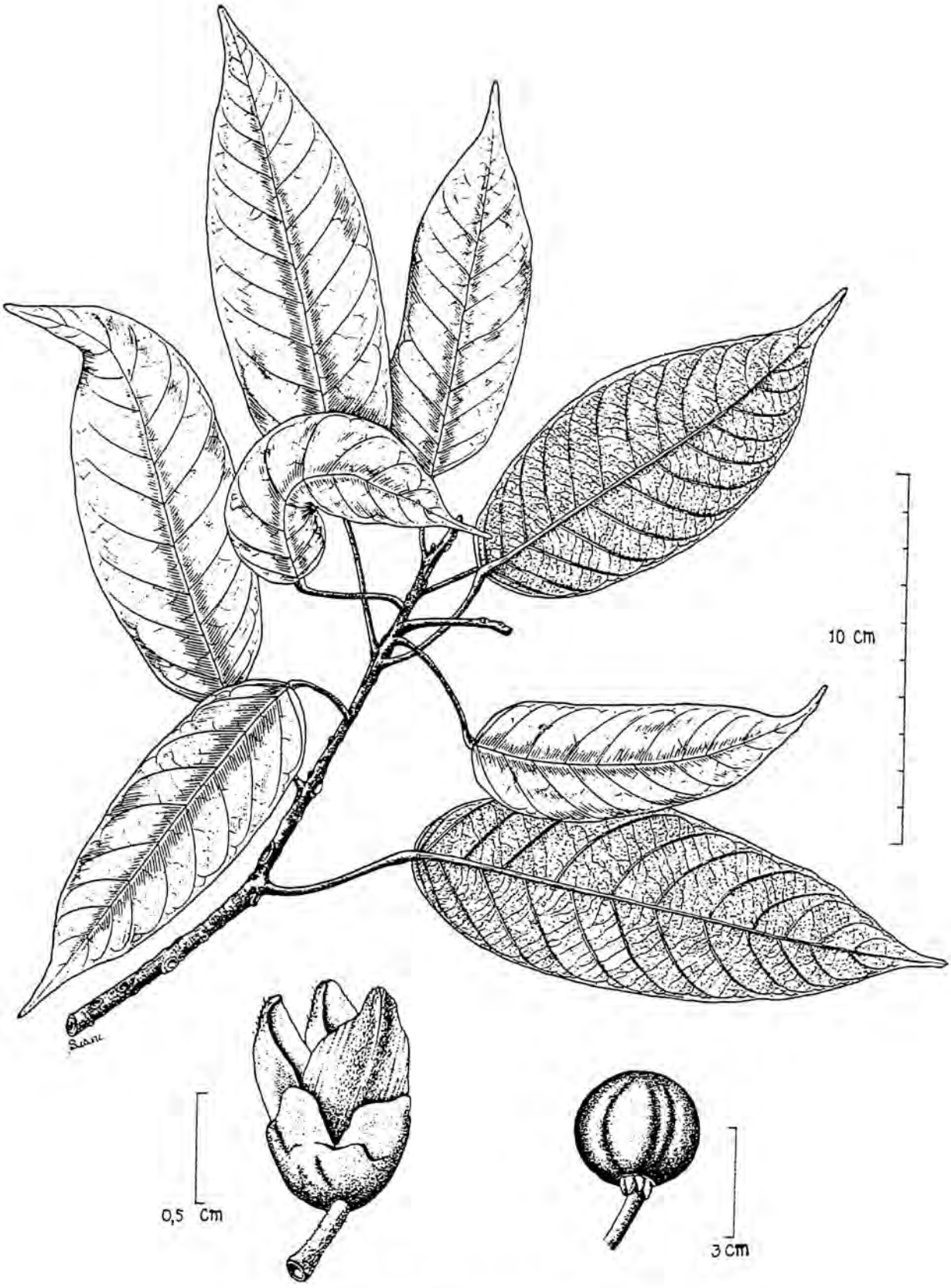

Fig. 41 *Stemonoporus canaliculatus* Thw.

Fig. 42 *Stemonoporus nitidus* Thw.

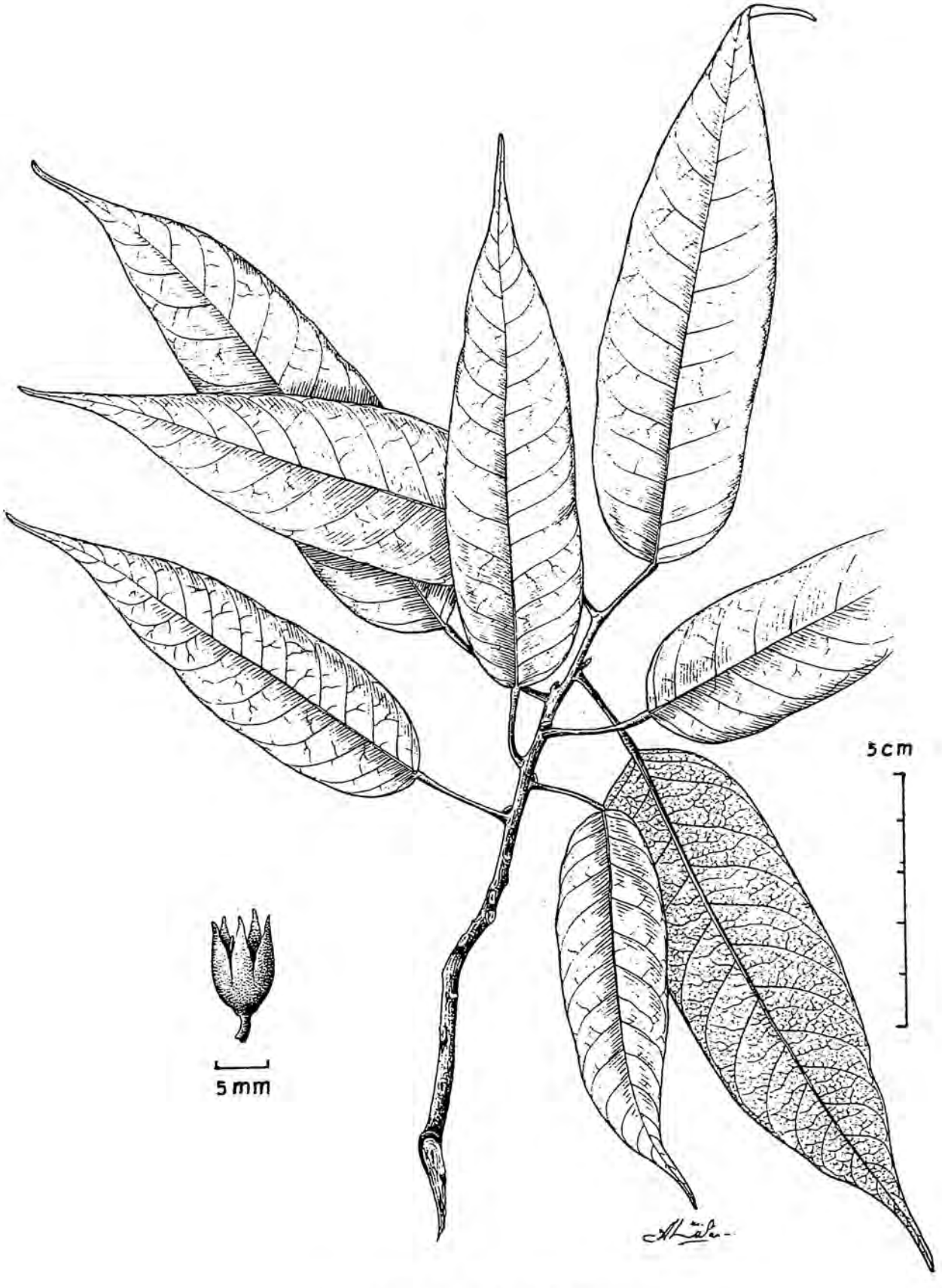

Fig. 43 *Stemonoporus laevifolius* Kosterm.

Fig. 44 *Stemonoporus reticulatus* Thw.

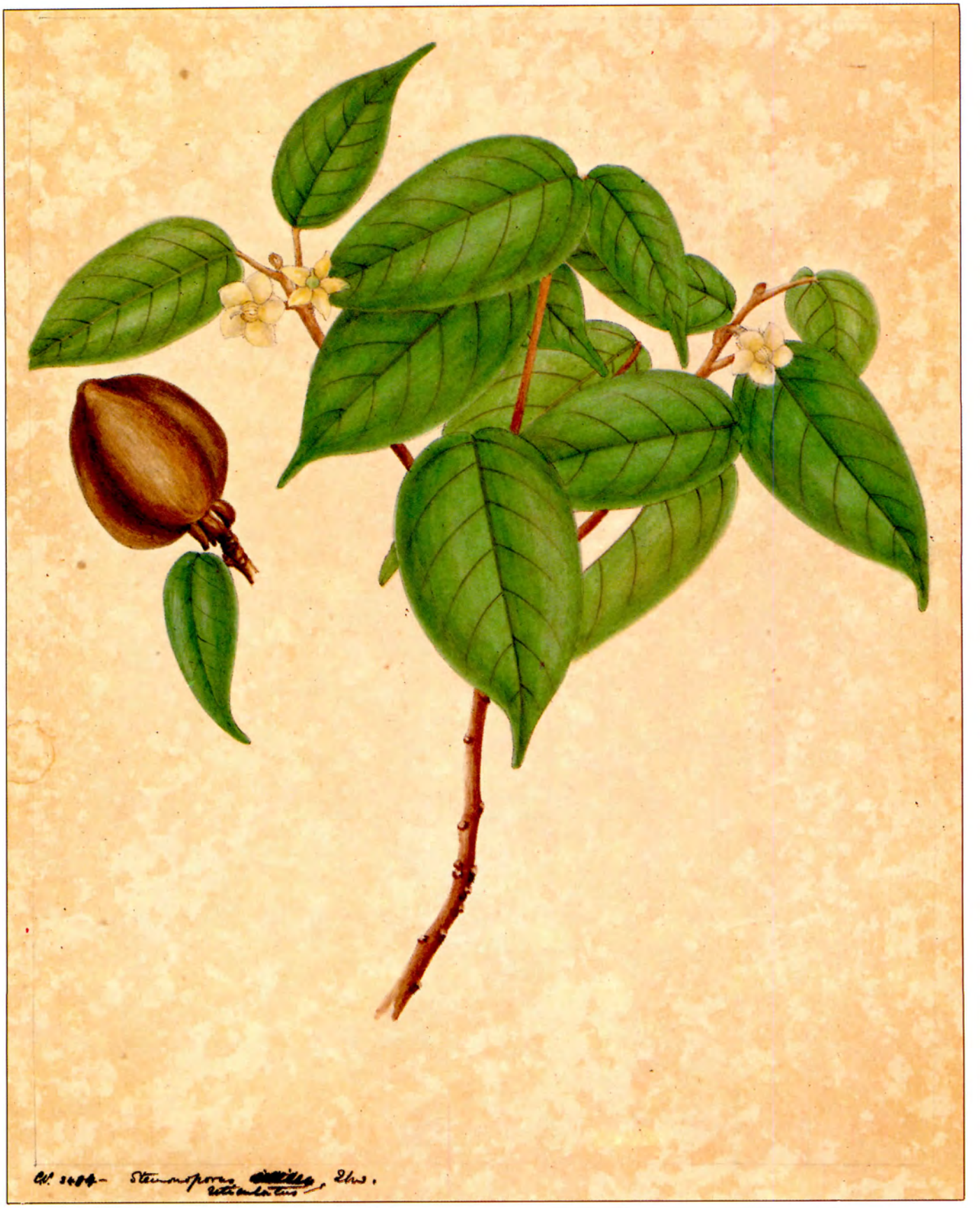

Fig. 44*a* *Stemonoporus reticulatus* Thw.

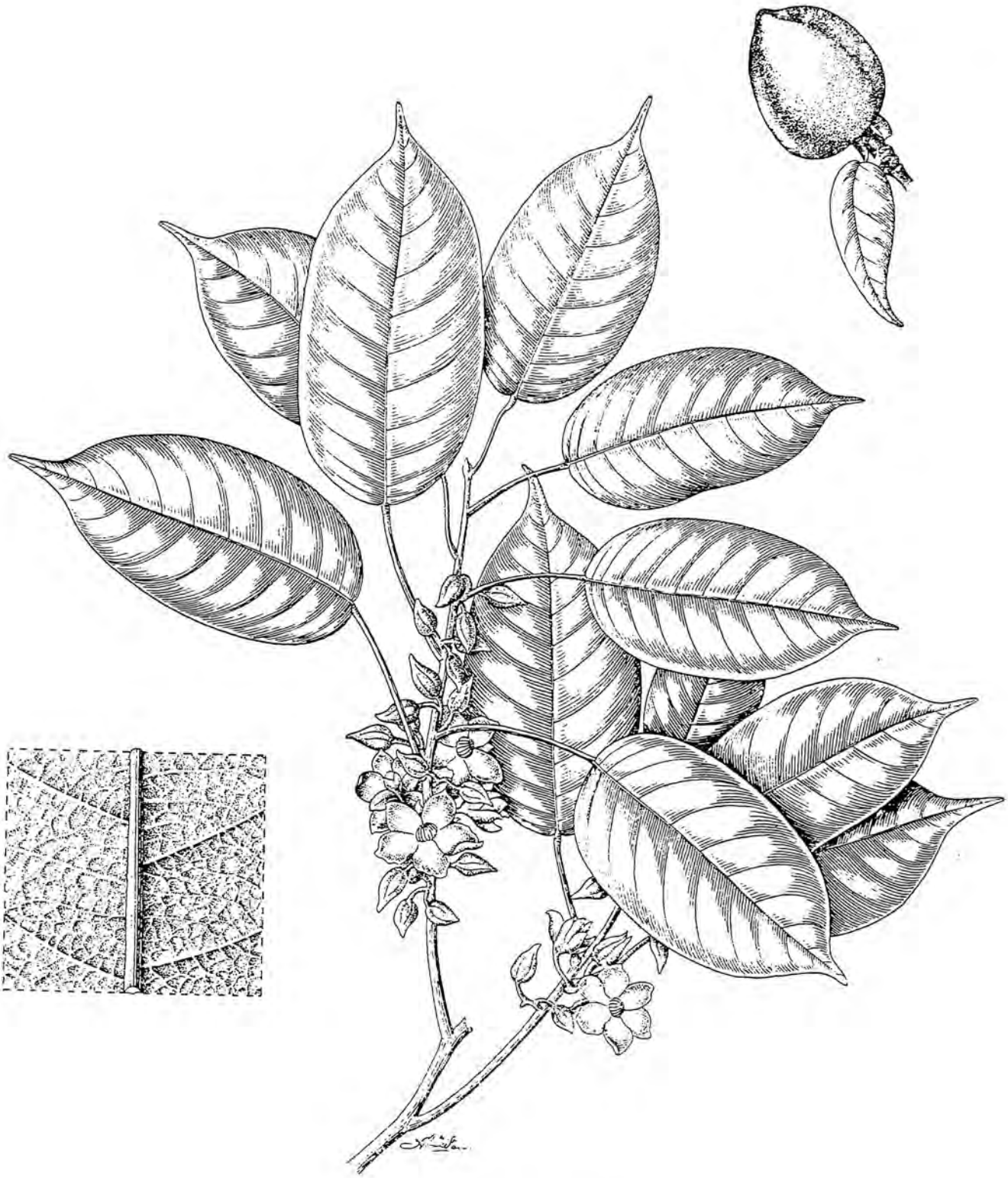

Fig. 44*b* *Stemonoporus reticulatus* Thw.

Fig. 45 *Stemonoporus rigidus* Thw.

Fig. 45*a* *Stemonoporus rigidus* Thw.

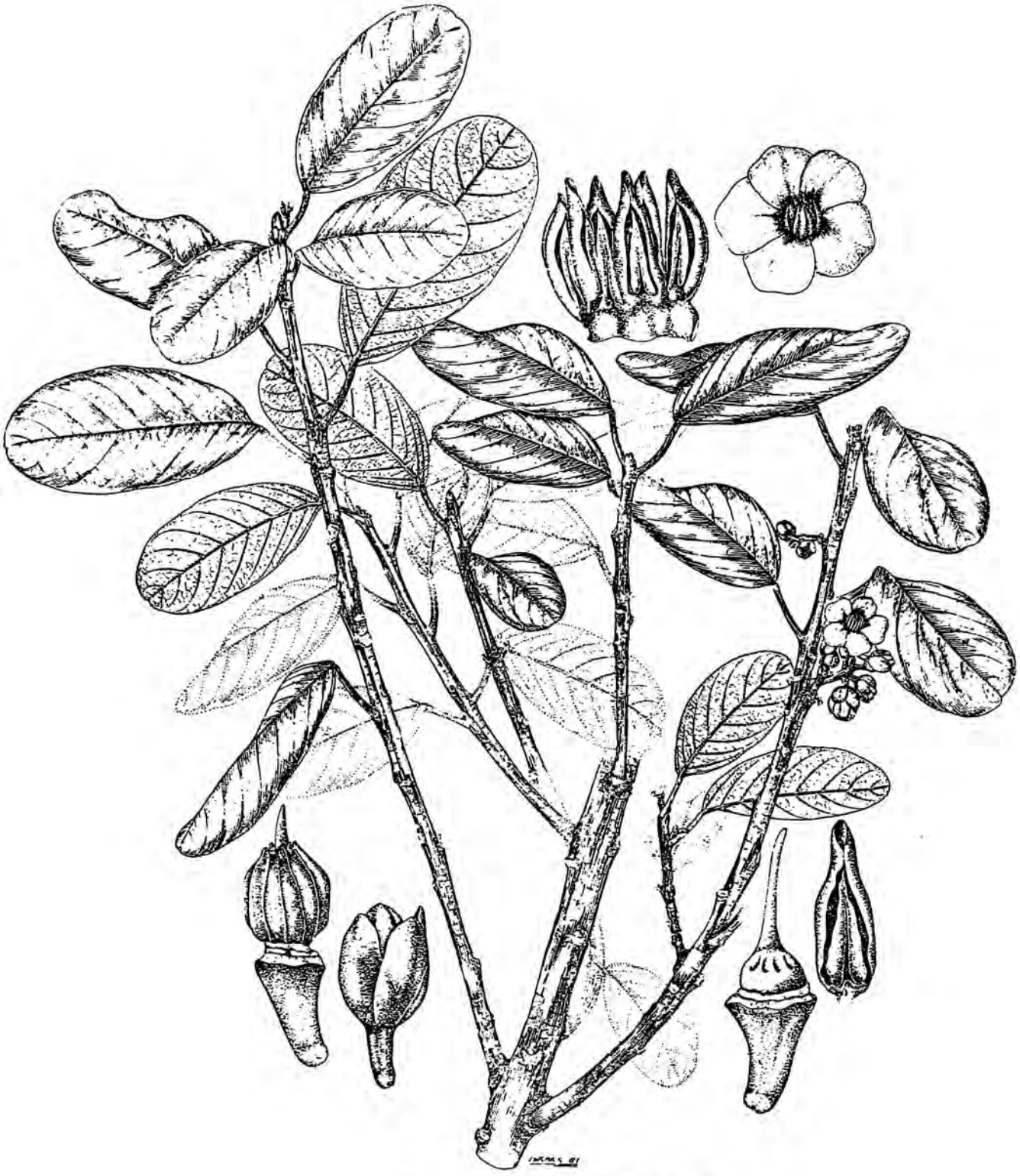

Fig. 46 *Stemonoporus oblongifolius* Thw.

Fig. 47 *Stemonoporus petiolaris* Thw. Ambagamuwa, Februaıy 1855.

Fig. 47*a* „*Stemonoporus petiolaris* Thw.

Fig. 48 *Stemonoporus wightii* Thw.

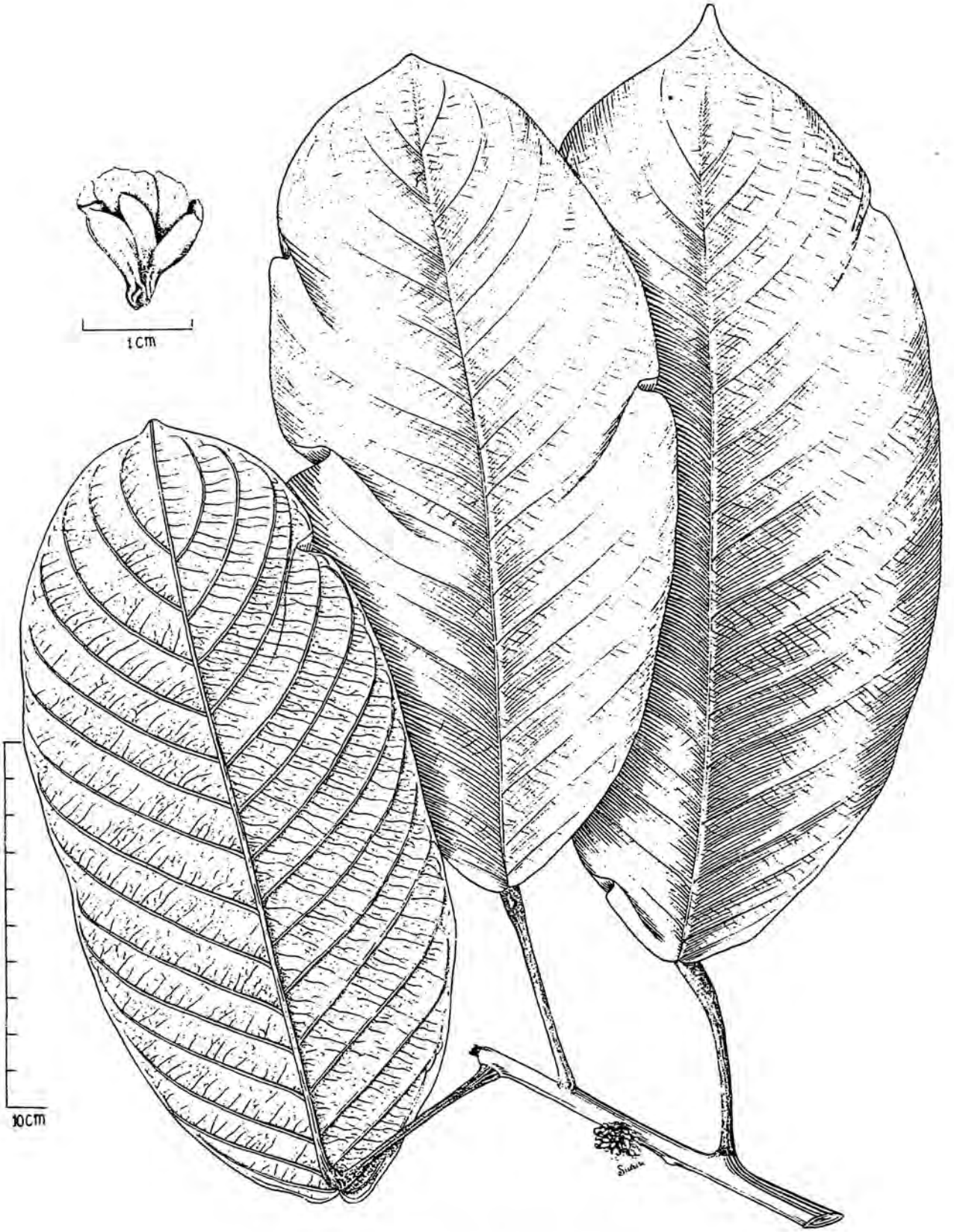

Fig. 49 *Stemonoporus gilimalensis* Kosterm.

Fig. 50 *Stemonoporus scalarinervis* Kosterm.

Fig. 51 *Stemonoporus lanceolatus* Thw.

Fig. 51*a* *Stemonoporus lanceolatus* Thw.

Fig. 52 *Stemonoporus latisepalum* Kosterm.

Fig. 53 *Stemonoporus affinis* Thw.

Fig. 54*a* *Stemonoporus acuminatus* (Thw.) Alston

Fig. 54 *Stemonoporus acuminatus* (Thw.) Alston

Fig. 55 *Stemonoporus moonii* Thw.

Fig. 55*a* *Stemonoporus moonii* Thw.

Fig. 55*b* *Stemonoporus moonii* Thw. with young pendulous leaves.

Fig. 56 *Stemonoporus cordifolius* (Thw.) Trim.

Fig. 56*a* *Stemonoporus cordifolius* (Thw.) Trim.

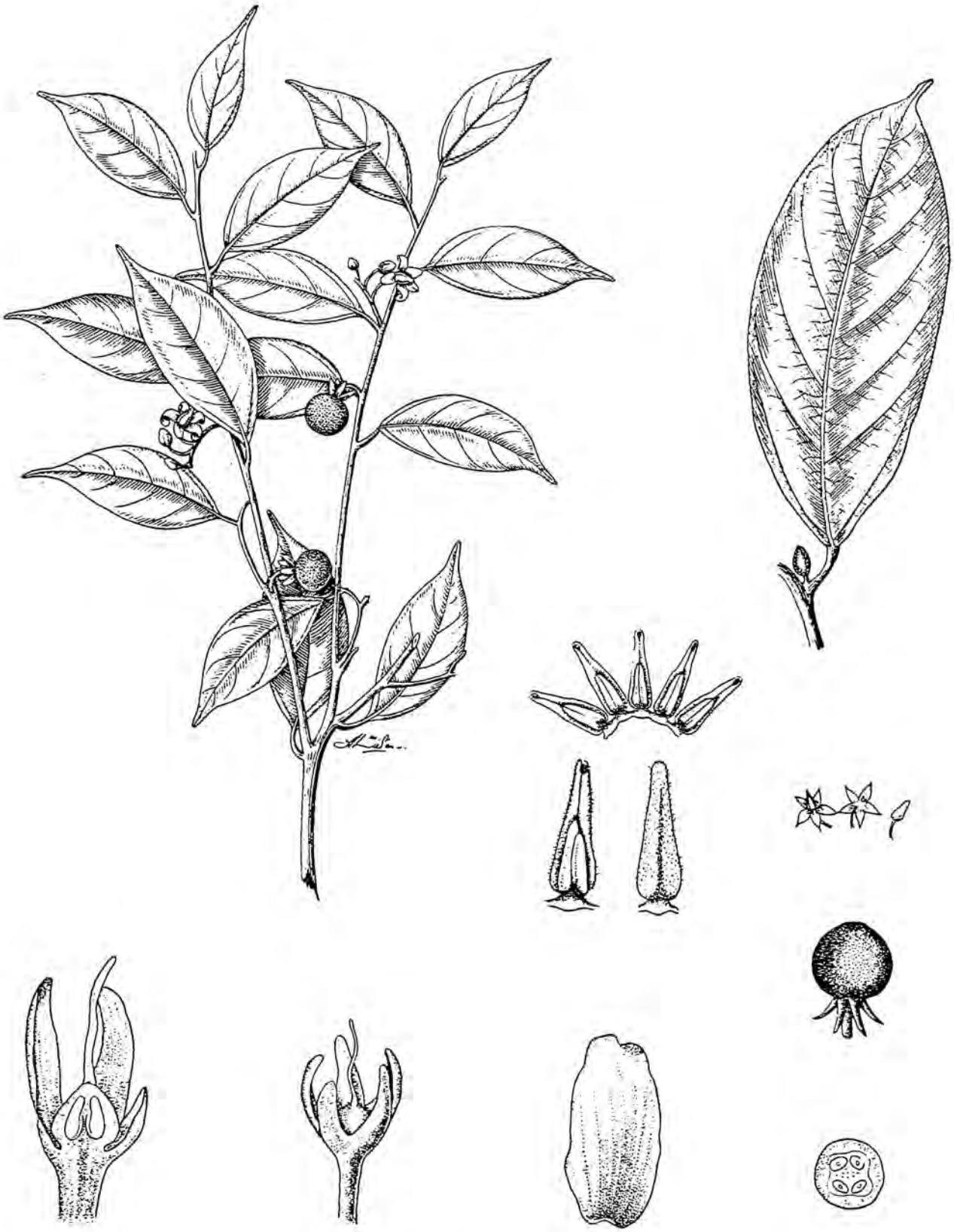

Fig. 57 *Stemonoporus elegans* (Thw.) Alston

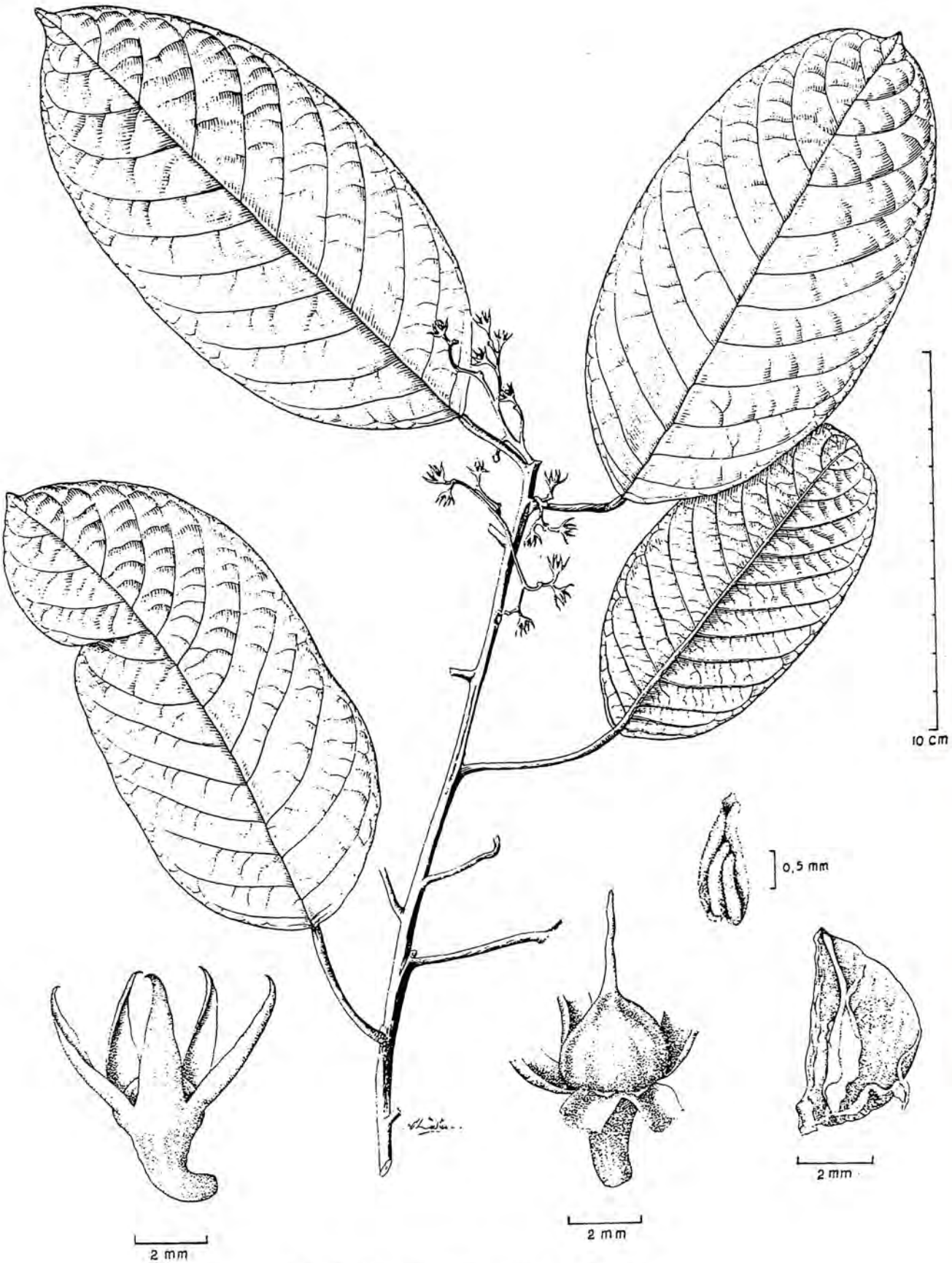

Fig. 58 *Stemonoporus angustisepalum* Kosterm.

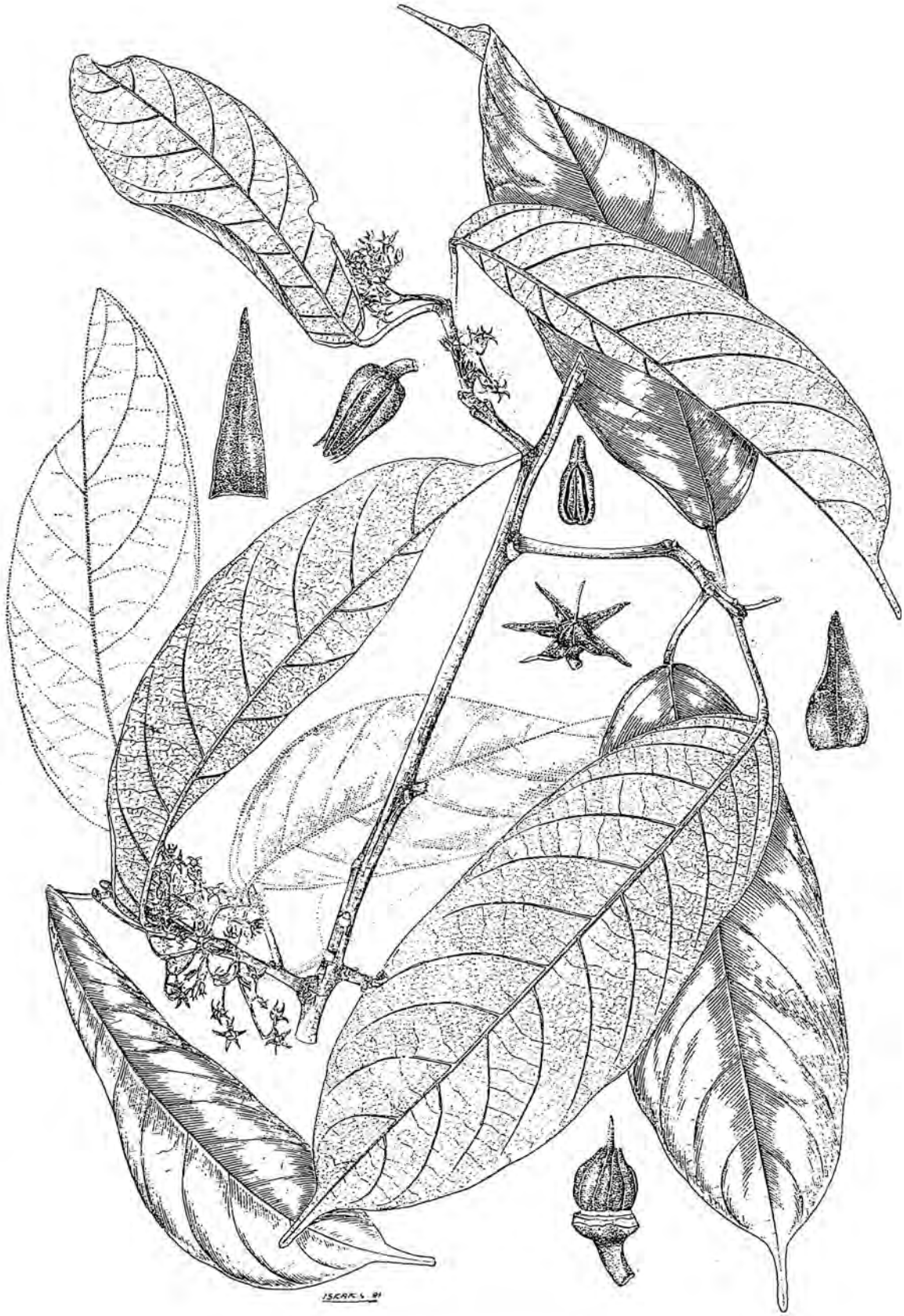

Fig. 59 *Stemonoporus scaphifolium* Kosterm.

Fig. 59*a* *Stemonoporus scaphifolium* Kosterm.

Fig. 60 Sinharaja forest, secondary vegetation after clear-felling, in the distance intact forest.

Fig. 61 Unspoilt dipterocarp forest near Weddegalle entrance of Sinharaja forest; foreground; result of clear-felling.

Fig. 62 *Doona trapezifolia* forest, above Moray Estate, Maskeliya

Fig. 63 *Doona congestiflora* and *Dipterocarpus hispidus*. E. part of Sinharaja forest